The Electrical Industry's Weekly Magazine May 1, 1961

Electrical World

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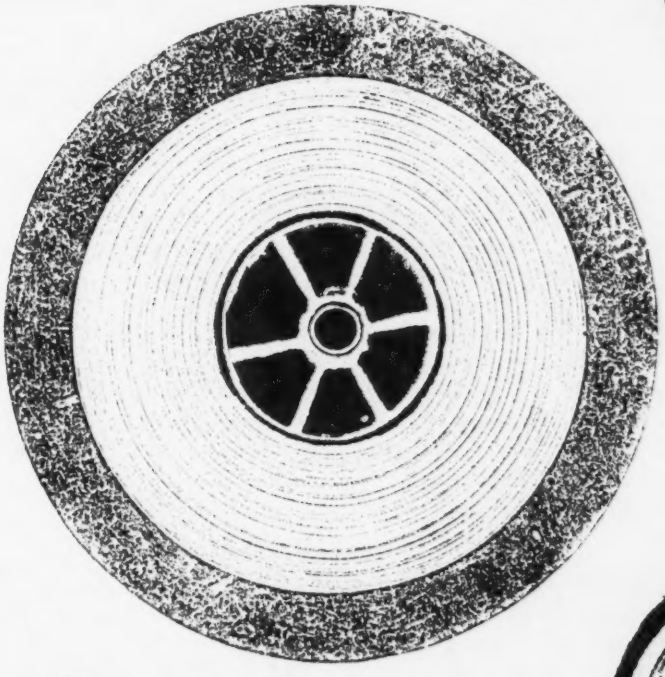
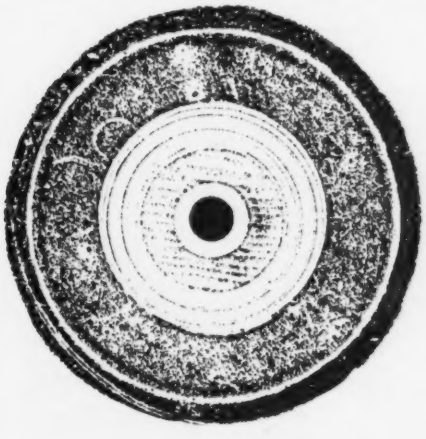


EHV Cables



Are Field Tested At Cornell...

...page 29

Which Kind of Preference at Hanford

Dateline . . . page 3

UNIV MICROFILMS INC GS
EDITORIAL DEPT
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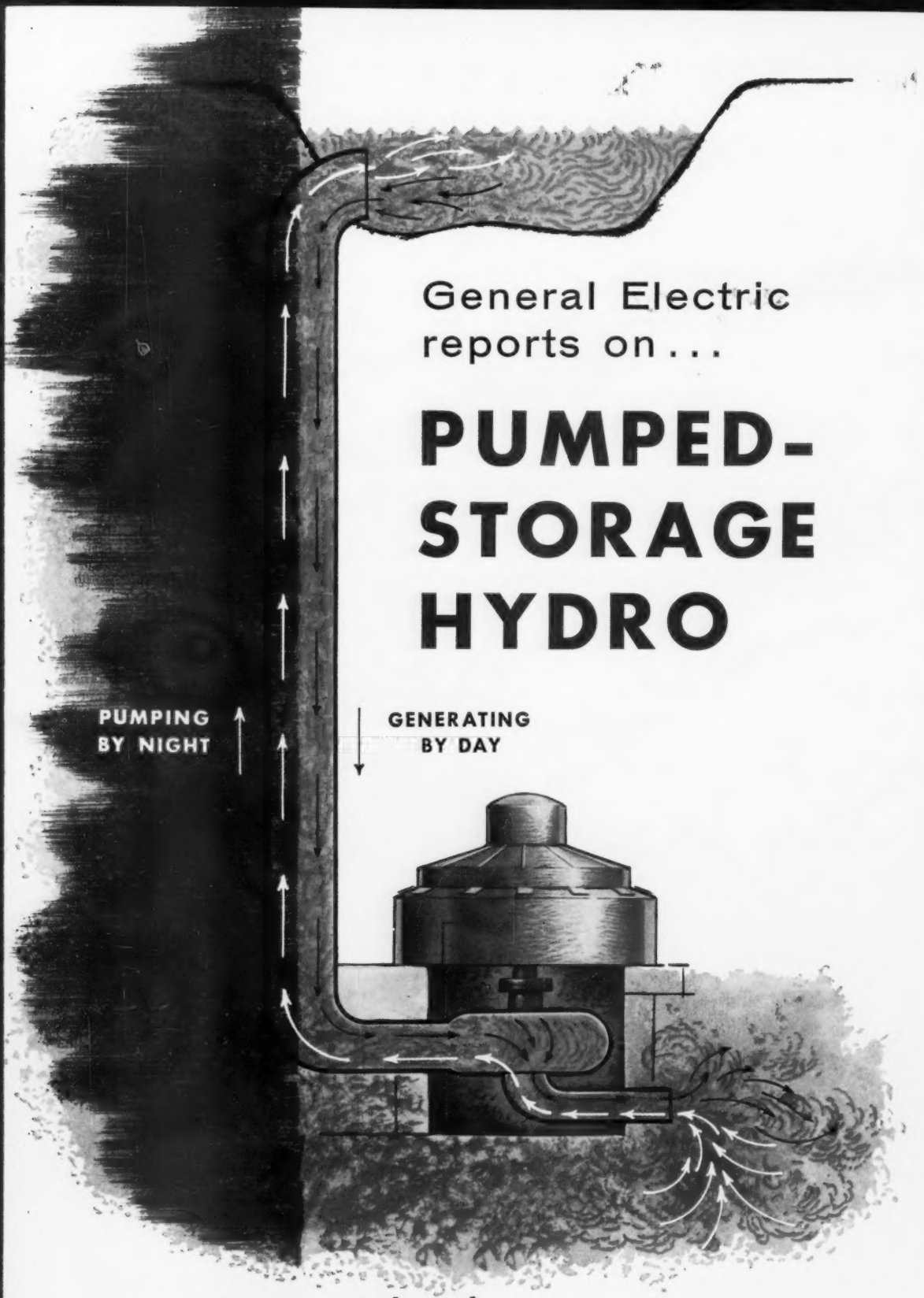
ANN ARBOR MICH

General Electric reports on...

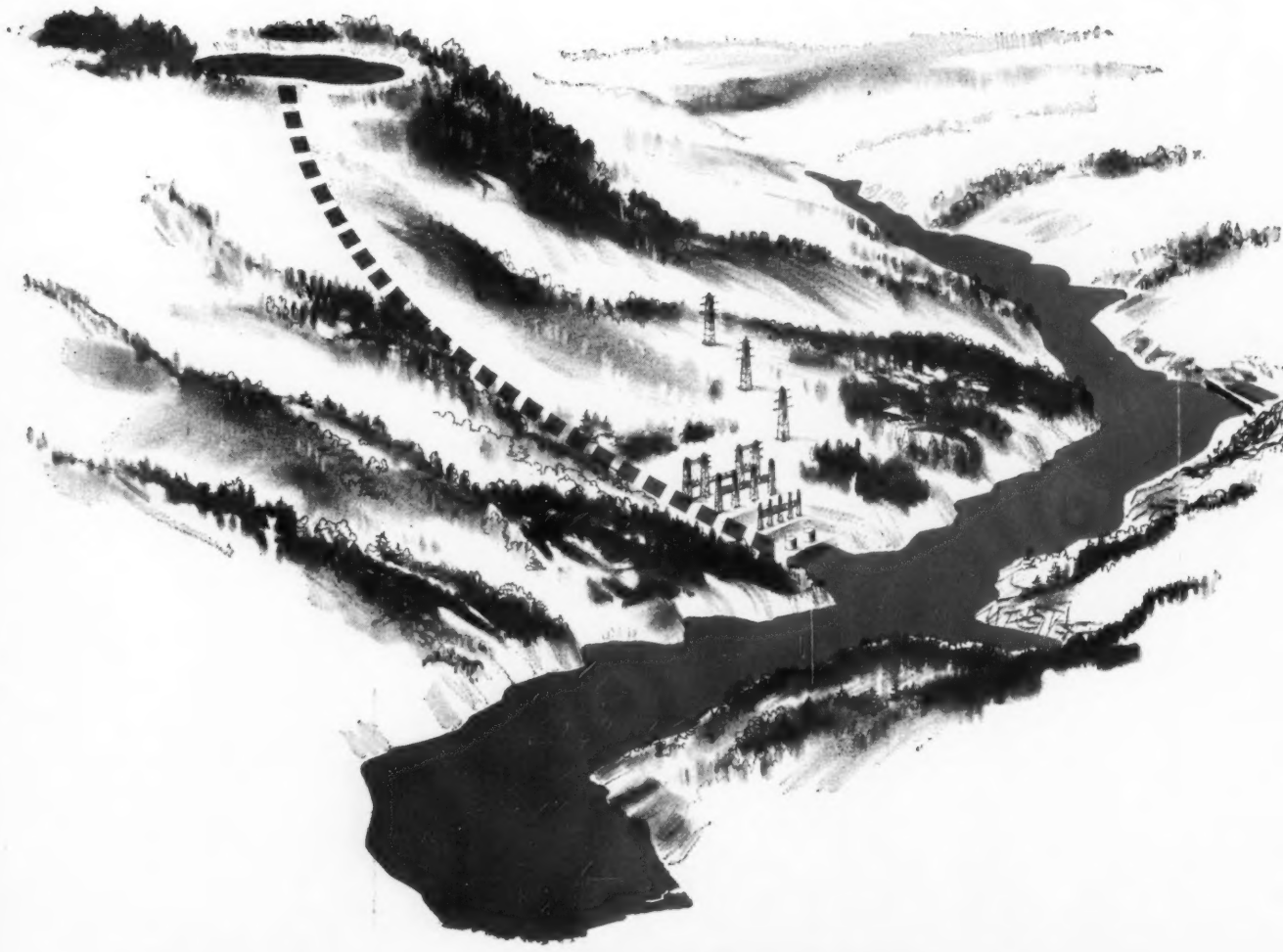
PUMPED-STORAGE HYDRO



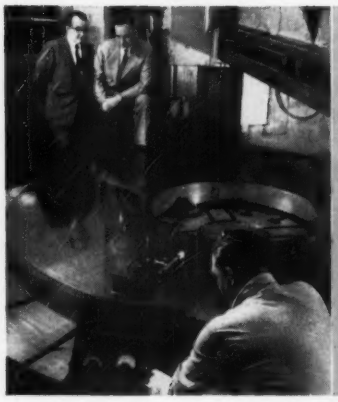
an economical approach to peaking

UNION ELECTRIC COMPANY'S TAUM SAUK PROJECT...

the world's largest pumped - st



TAUM SAUK involves the creation of two lakes in the Missouri Ozarks—one at the confluence of Taum Sauk Creek and the East Fork of the Black River, the other covering about 50 acres on top of a nearby mountain 800 feet above the lower lake.



HIGHLY POLISHED SURFACE of thrust bearing runner plate assures dependable operation of G-E hydro-generators. In operation, comparable bearings are supporting loads of over 4,000,000 pounds. Watching the operator check surface smoothness are R. B. Bodine (left) and R. B. McKeeby of G.E.'s Large Motor & Generator Dept.

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torage plant will provide economical peaking

Union Electric Company, after six years of intensive study, recently initiated its Taum Sauk project—the world's largest pumped-storage hydroelectric power development, to be completed in 1963. Pumping water to a mountain-top reservoir by night and releasing the water by day to generate 350,000 peak-load kilowatts, Taum Sauk will serve as an economical addition to the Union Electric system.

ECONOMICAL PEAKING

- By building Taum Sauk (estimated to cost $50 million), Union Electric can postpone for two years the construction of an $80 million steam plant.
- Two valuable peak-load kilowatt-hours will be delivered for each three off-peak kilowatt-hours supplied, at fuel cost only, by otherwise idle steam units. More continuous use of its steam units will let Union Electric spread fixed costs for operation and maintenance over a greater kilowatt-hour output.
- Water held in the mountain-top reservoir will represent instantaneous reserve in case of unexpected breakdown of other generating equipment.
- Lower maintenance costs, savings associated with automated operation, and longer service life are typical hydro-plant benefits available to Taum Sauk.

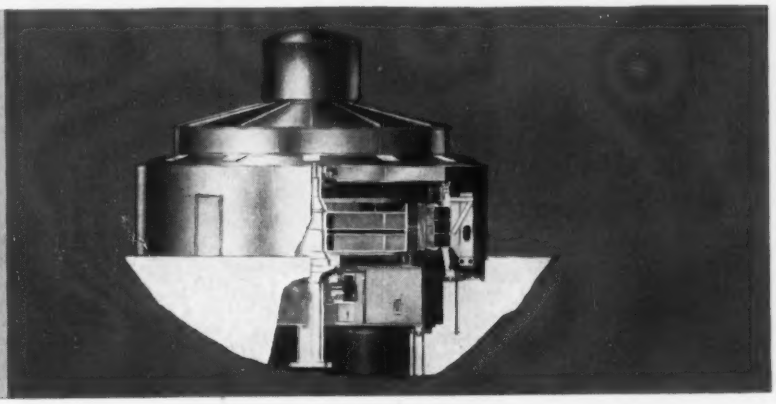
PARTNERSHIP IN INNOVATION

General Electric, as supplier of the world's largest generator/motors (204,000-kva, 240,000-hp) for Taum Sauk, is proud to be associated with Union Electric in this ambitious undertaking. Taum Sauk is a significant example of the partnership of electric utilities and manufacturers in the search for new and better ways to serve growing loads while keeping the cost of power low.

TREND TO HYDRO

More and more hydro plants, both pumped-storage and natural-head, will be constructed in the future to meet peak-load requirements. The reason: energy costs are reduced by better utilization of larger steam units and nuclear plants, which are operated most economically at base load. General Electric, which has supplied more than 2000 hydro-generators during the past 75 years, is well-qualified to work with you on your hydroelectric project. Call your G-E Sales Engineer or request bulletin GEA-2251F from General Electric Company, Section 604-15, Schenectady 5, N. Y.

S CROSS-SECTION illustrates one pe G-E reversible generator/motors pe furnished for Taum Sauk. At t, these generator/motors will use peak power from the system's m equipment to turn the blades two hydraulic turbines, pumping er from the lower level, through a el, to the mountain-top reservoir. ng daytime peak periods, the er is released from the mountain- "storage battery," and the pment is reversed to generate ,000 kw for as long as eight hours.



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Electrical World

MAY 1, 1961
Vol. 155, No. 18

Dateline . . .

Which Kind of Preference for Hanford?

Washington, D. C.—Power from the proposed generating facilities at the Hanford, Wash., nuclear reactor is expected to be marketed under some sort of preference clause.

This is regarded in Washington as a fact of life in 1961, regardless of Sen Clinton Anderson's (D-N. M.) statements in 1958, when, as chairman of the Joint Atomic Energy Committee, he held that power should not be exported from the reactor, and that any such power should not be tied to preference: "I hope we will put such restrictions on the power that it will not become public power in the ordinary sense of being subject to a preference clause for the sale of power to cooperatives. It need not be, and it should not be."

Anderson added that when the Senate considers Hanford generating facilities, "I hope to make sure we are not considering current which would ever be generated by the government to put the government into the public power business."

And Sen John Pastore (D-R. I.), slated to be chairman of the Joint Committee in 1963, also said in 1958 that he doubted if power would be exported from Hanford. He asked, "Will power which will go into the grid of either private or public utilities in that area be produced (at Hanford)? Of course not. Instead, we shall produce only 300 Mw of electric power, which is needed very badly at Hanford . . ."

Sens Henry Jackson (D-Wash.), Pastore and Anderson all denied contentions in 1958 by Sen Leverett Saltonstall (R-Mass.) that Hanford's dual-purpose facilities, to generate power, might set the stage for a public-private power fight in later years.

There's no outward sign of such a fight developing this year over appropriation or authorization bills for Hanford generation. But these statements should be repeated for the record, as they were used as grease to ease through the original, $25-million dual-purpose features at Hanford when it was authorized—a significant step leading to getting the federal

(*Continued on page 5*)

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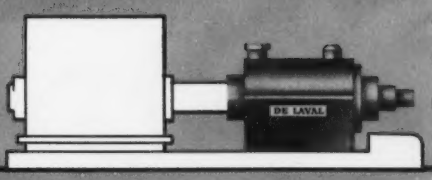
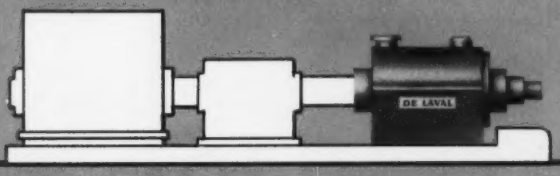
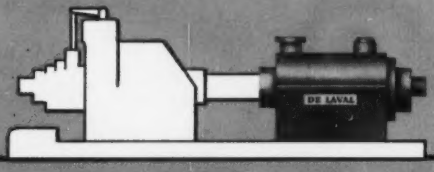


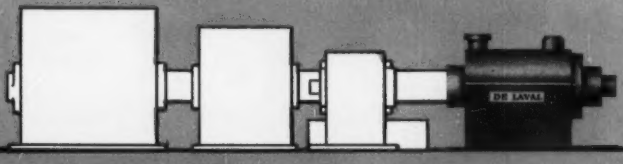
Motor-Hydraulic Coupling Drive
Commonwealth Edison Co.
5000 HP 325 MW



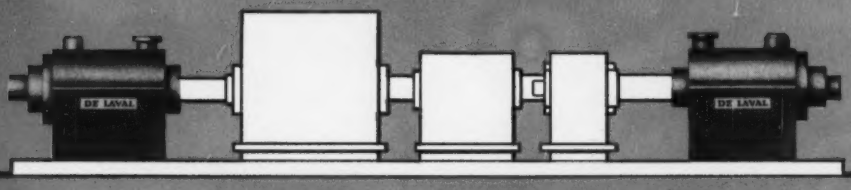
Turbine Drive
United States Steel Corporation
1400 HP 44 MW



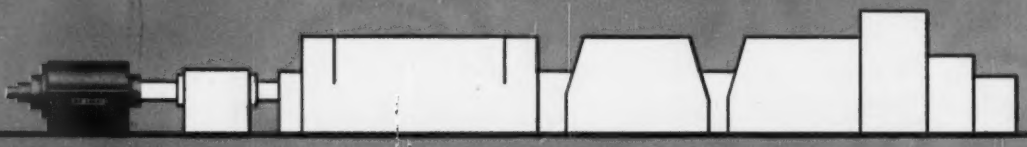
Motor-Magnetic Coupling—Gear Drive
South Carolina Electric & Gas Co.
2500 HP 5100 RPM
125 MW



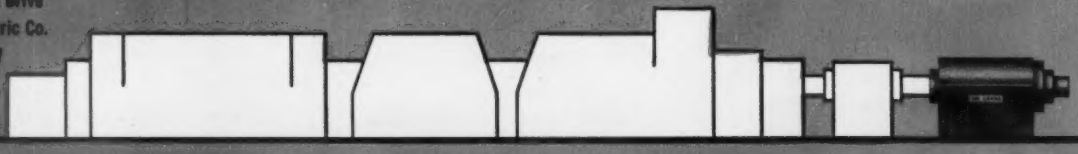
Supercritical Cycle
American Electric Power System
4000 HP 6500 RPM 5500 PSIG 120 MW



Main Generator-Shaft Drive
Commonwealth Edison Co.
4900 HP 325 MW
(FUTURE UNIT)



Main Turbine-Shaft Drive
Pacific Gas & Electric Co.
5250 HP 330 MW



DE LAVAL STEAM TURBINE COMPANY
861 NOTTINGHAM WAY, TRENTON 2, N. J.

Dateline . . .

Washington, D. C. (*Continued from page* 3)
government into thermal generation.

But those earlier statements are only "for the record" now. Now the situation looks to be this way: **(1)** 763 Mw of power will be exported from Hanford, **(2)** it will be sold under some preference version. Authorizing legislation is now being drafted by the AEC, and possible preference versions for Hanford power are these:

Bonneville preference—Since Hanford power will be marketed over Bonneville lines, it will take a specific action (either a clause in the new Hanford bill, or a Presidential directive) to change this. Otherwise, Hanford power will be sold to preference customers on the same basis as Bonneville's hydro-generated power.

Atomic energy preference—Hanford could sell its power under the Atomic Energy Act's preference clause (Sec. 44). This requires: "preference and priority to public bodies and cooperatives or to privately owned utilities providing electric utility services to high cost areas not being served by public bodies or cooperatives."

A new, softer preference version—This could be caused by: **(1)** The Anderson-Pastore-Jackson statements, **(2)** A question as to whether Northwest preference customers could take all of Hanford's power, **(3)** A growing feeling that preference should be tempered with geographic considerations so that private utilities in an area would be able to buy some power.

Interior Secretary Stewart Udall says the Hanford power makes the Bonneville-California intertie a necessity. There is already a legal cloud over how Bonneville's preference power might be sold in California. And Udall's implication that Hanford power also would find its way south could produce a softer, or geographically-limited preference version when Hanford's power features are authorized.

Letters

Inference Would Be Wrong

To the Editor:

Your April 17th issue carried a mention of S & C Electric Co in such a manner as to perhaps permit some readers to infer that S & C was among those firms recently indicted in the antitrust actions against some electrical manufacturers.

For the record, may I make clear that S & C was not indicted.

John R. Conrad
S & C Electric Co
Chicago, 40, Ill.

Which Way Transmission Voltages?

To the Editor:

This refers to your editorial, "Prospects Brighten for EHV Standard Levels" (EW, Mar. 27, p 43).

Apparently you are in agreement with the action of ASA Sectional Committee C-92 in endorsing 345, 500, and 700 kv as American Standard Voltage Levels.

Although you cast a skeptical eye on the historical pattern of even increments of 115 kv which lead to the 460-kv level considered by some as the next EHV step, you seem to endorse the perpetuation of the old transmission voltage rivalry which permeated the industry over past decades. If I read your endorsement correctly, you agree that the old transmission voltage series 57-115-230-460 kv is perfectly all right provided the 460-kv step is rounded to 500 kv.

Also you are in agreement with the competing transmission voltage series 44-88-138-345-690 kv provided the 690-kv step is rounded to 700 kv.

In essence what you are saying is look what a mess we have made of the transmission voltage pattern in the past and now we are offering to extend part of that mess into the future, but in a rounded form . . .

It seems to me that it is time for the industry to cut out this transmission voltage rivalry and agree that 345 kv has arrived as a transmission step fully acceptable for today's needs. With generating units of 500 Mw to 1,000 Mw definitely in the electric utility picture and with the mounting premium being placed on transmission right-of-ways, the industry can no longer afford

(*Continued on page* 50)

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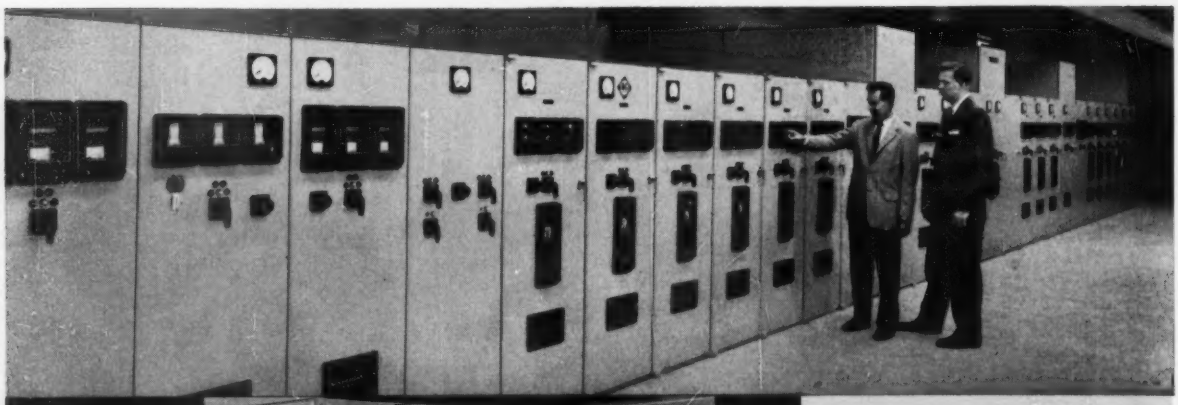

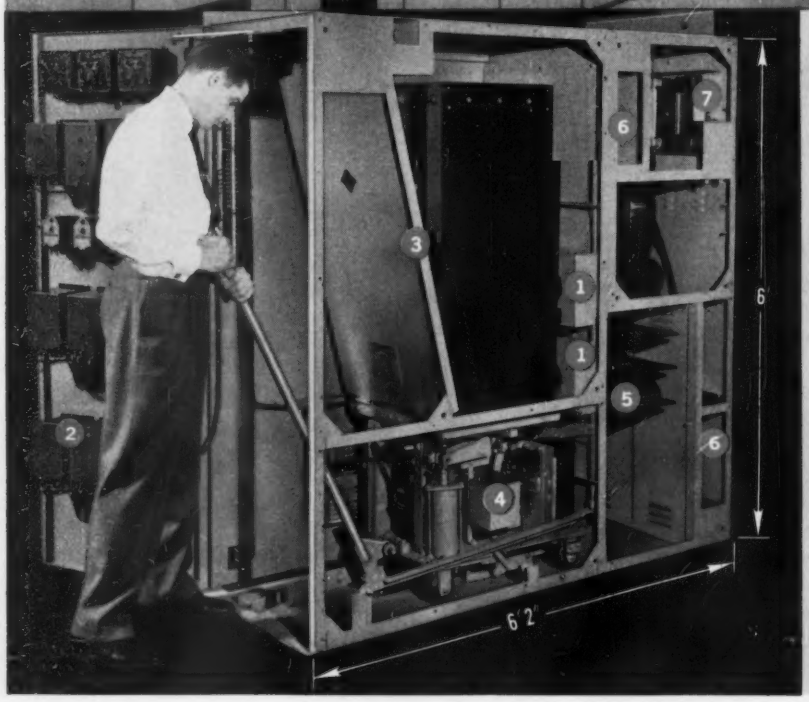

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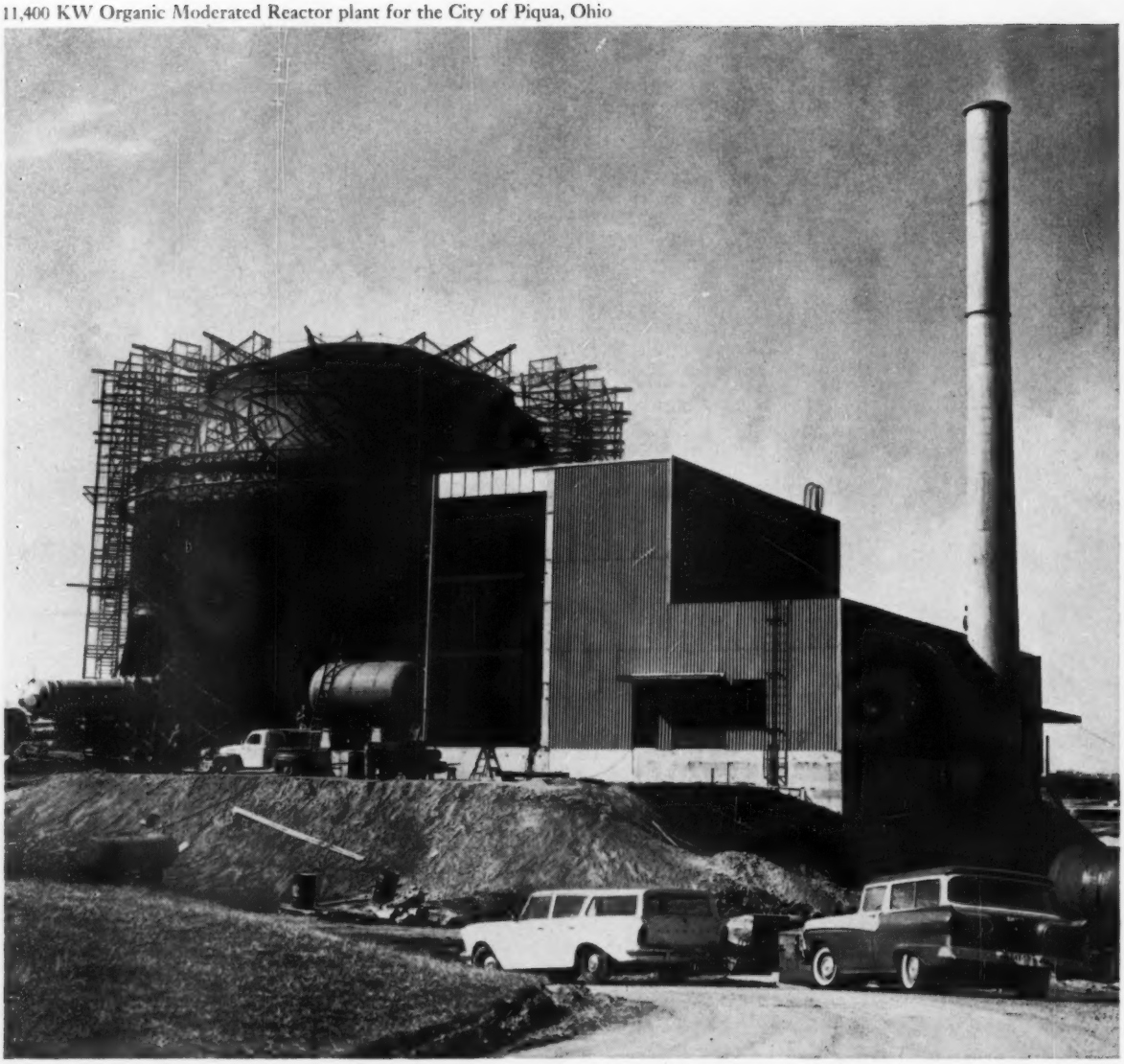

The Peaceful Atom

Answering the challenge of the Sixties: to double the world's power output in ten years

To meet increased living standards everywhere, the world's power resources must be doubled in the 1960's. In this great expansion the Peaceful Atom will play an ever-increasing role. Atomics International, a leader in developing nuclear power for over 15 years, is already building two of the world's most advanced power stations under AEC programs: the Organic Reactor plant at Piqua, Ohio and the Sodium Reactor plant at Hallam, Nebraska. Another promising concept is the Advanced Epithermal Thorium Reactor project, now being developed by AI for the Southwest Atomic Energy Associates, a group of investor-owned utilities. AI's experience and facilities will play a growing part in meeting the power challenge of the Sixties.

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our demonstration area at last year's
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We'll be at The Sheraton in Philadelphia
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Exclusive Lapp Process Stabilizes Power Factor and Loss in Post Insulators

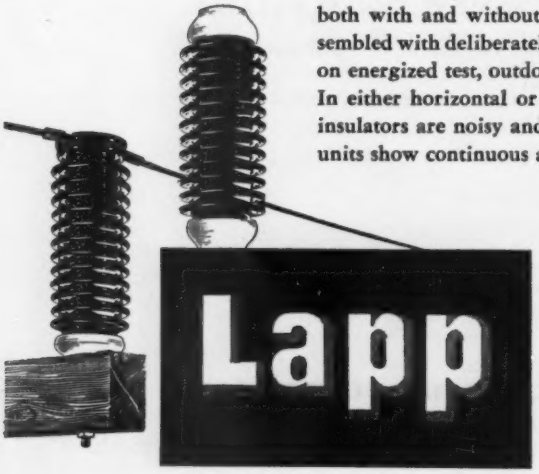
A LAPP LABORATORY REPORT

THE PROBLEM: Line Post and Station Post insulators occasionally have been found to show variation in power factor, charging current and watts loss under Doble tests. Field service seems not to have been impaired, but the phenomenon has been noticeable in such instances as erratic readings secured in tests of bushings connected to Post insulators.

THE FINDING: Some years ago engineers of the Lapp Laboratory staff were assigned the job of tracing down the cause of such variations. It was located and identified as contamination deposits on the inside walls of the insulators. Porcelain bodies for Lapp Post insulators are subjected to a severe test for electrical soundness—a 3-minute flashover from the inside of the head around the body to the outside of the head. During this test the hole in the insulator fills with corona, and contaminating particles deposit on the walls of the hole; amount of this deposit and its effect on electrical characteristics vary with atmospheric conditions at the time of the test and at the time of plugging the hole for assembly.

THE SOLUTION: A thin coating of silicone applied to the wall of the insulator hole negates the effect of the corona contamination, and results in insulators dependably uniform in power factor, charging current and watts loss. Permanent effectiveness of the silicone coating is assured by its inherent chemical stability, and by the fact that the hole to which it is applied is sealed by the Lapp plug against weather, light, heat, or other physical or electrical attack. A Lapp patent is pending on the process.

THE VERIFICATION: All Lapp Line Post and Station Post insulator production for more than three years has incorporated the silicone treatment. The low initial power factor of the insulator has been maintained on every unit re-tested after service. In addition, in an effort to determine limits of effectiveness of the process, a series of insulators has been set up in the Lapp laboratory. Post insulators, both with and without the silicone treatment, were assembled with deliberately-defective plugs. They have been on energized test, outdoors, continuously for three years. In either horizontal or vertical mounting, all untreated insulators are noisy and show high loss. Silicone-treated units show continuous and unchanging low loss.



THE CONCLUSION: To the widely-known advantages, in electrical and physical performance, of its Post insulators, Lapp research has added the characteristic of stability in power factor, charging current and watts loss. *At Lapp, insulator design and production is a matter of continuous development and improvement.*

Lapp Insulator Co., Inc., Le Roy, N. Y.

Electrical World

MAY 1, 1961
Vol. 155, No. 18

Preview of the Issue

DEPARTMENTS

Editorial Comment..... 23
Dateline 3
Letters 5
Electrical Week..... 12
Supply Lines..... 13
EUM 44
Manufacturers News..... 46
New Equipment..... 54
Management Newsletter.. 57
Selling 62
News About People..... 63
News Scope..... 68
Advertising Index..... 68

● **EHV CABLE FIELD TESTS at Cornell seek to determine electrical, thermal, mechanical performance and stability of paper-and-oil cable**..... 29

Cable's copper components are coated with tin or alloy..... 30

Copper-oil contact is minimized by system and cable design..... 31

System features low-pressure, oil-filled aluminum sheath..... 34

Oil-filled cable has self-contained design..... 35

Condenser pothead uses doughnut pattern..... 35

Assembled parts speed pothead installation..... 53

● **'COPTER HALVES CONSTRUCTION TIME for transmission line, strings conductors and winch lines, transports and sets wood poles and assembled towers**..... 36

CURRENT EVENTS

TOP BRASS ORDERED PRICE-FIX MEETINGS, four former General Electric executives testify at Kefauver antitrust hearings..... 24

CONSOLIDATED FIRM PROPOSAL for 360-Mw reactor is filed with AEC by SoCalEd, Westinghouse and Bechtel . . . FPC will rule on Nez Perce motion..... 25

UTILITIES DID PRETTY WELL in their battles on the state legislature circuit . . . Rock-wielding youths are given a bull's-eye substitute for substation insulators..... 26

COLUMBIA BASIN COORDINATION moves ahead as utility representatives meet with BPA and Corps of Engineers men to dope out more detailed plans..... 27

DATELINE

WHO'LL GET THE POWER exported from Hanford for sale on a preference basis? There's a good chance it will be peddled on a geographically limited basis..... 3

ELECTRIC UTILITY METHODS

HANDLING COSTS ARE CUT by using aluminum cable reels rather than conventional steel or wood ones . . . Rig holds small parts, making for tidy overhauls..... 44

INTERNATIONAL

SUBMARINE CABLES are planned to span Cook Strait in New Zealand and to link Sweden with mainland Europe . . . Two Manitoba government agencies are integrated to form single utility 25

MANAGEMENT

LOOKING UP: Recession clouds are fading as more and more companies firm up their expansion plans. Utilities, which would like to see more expansion investment, find much to be happy about in the present business trend..... 57

TRADE-IN OFFER is asked by Cleveland to discourage identical meter bids . . . GE declines cash settlement, says customer wasn't overcharged..... 13

MANUFACTURERS NEWS

BRITISH TURBOJET EXPERIMENT has panned out into a standard 3-Mw turbojet-powered generator . . . Vacuum-cast steel is supplied for turbine forgings at no increase in price.... 46

MEETINGS

UTILITY BOUNDARIES originally set by politics, geography and corporate limits must not hinder the system integration move, EEI's Knapp declares at Southwest conference..... 28

NEXT WEEK

TAUM SAUK will provide 350 Mw of peaking hydro.

The Electrical Week

LATE NEWS ▶ **GE Chairman Ralph J. Cordiner receives long round of applause** from some 3,000 stockholders present at company's annual meeting in Syracuse, N. Y. During the long and at times unruly meeting, the sentiments of the bulk of those present are clearly with Cordiner, but several stockholders question him sharply concerning antitrust cases. The GE chairman says that he, "from the outset, assumed the ultimate responsibility for the violations, as must any chief executive officer." He indicates that he has no intention of resigning. Cordiner says individuals involved in the cases made a "mistake" and acknowledged that top management had "failed" in communicating the company's antitrust policy to its employees. In summing up, he emphasizes that GE "has a new spirit, perhaps born at a time of challenge."

About 10 days ahead of schedule, Dresden nuclear power station goes on the line after modification of the reactor's control rod drives and blades. AEC approval to go ahead with critical testing was received Apr. 17, and reactor went critical three days later. After low level critical testing, the reactor core will be reloaded and plant will be brought back into power operation when the AEC operating license is received.

President Kennedy orders that all identical bids over $10,000 on government work be reported to the Justice Department. He says principal purpose of order is to make antitrust laws more effective. The order says collection and dissemination of information about identical bids submitted to the government "will discourage future submissions of such bids. . . " Attorney General is directed to compile reports of identical bids and submit them to Congress.

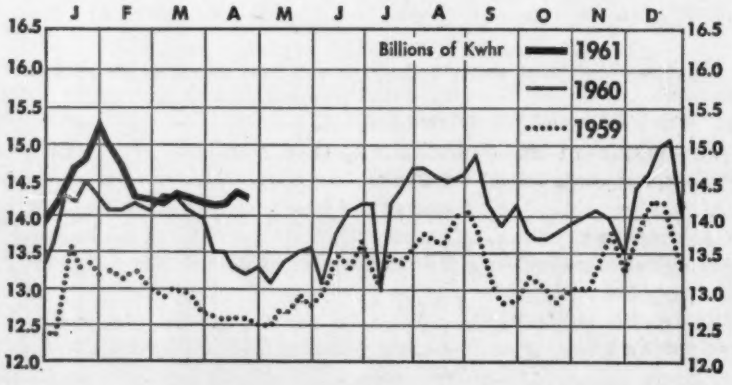
Allis Chalmers Mfg Co releases report intended to disprove allegation that purchasers of electrical equipment have been overcharged. It calls certain allegations as to prospective damage arising from antitrust actions "loose and unfounded" and accused some statements of "bordering on the fantastic."

Award for eight generators for Glen Canyon Dam goes to GE. Foreign firms bid lower, but Reclamation Commissioner Floyd E. Dominy says labor surplus in the Schenectady area is major factor in award to GE.

Corps of Engineers starts mobilization of survey teams and engineers for full-scale studies at Libby Dam (Mont.) site.

Weekly Power Output down in every region except South Central.

WEEKLY POWER OUTPUT—Up 5.5% (Week ending Apr. 22), Kwhr 14,311,000,000



Percent Change From Previous Year

	Apr. 8	Apr. 15	Apr. 22
Total U. S.	+ 2.4	+ 6.0	+ 5.5
New Eng.	+ 2.5	+10.0	+ 8.1
Mid. Atlan. ...	+ 0.9	+ 8.1	+ 7.9
Cent. Indust....	− 3.5	+ 2.3	+ 1.8
West Cent. ...	+ 4.3	+ 8.2	+ 8.1
Southeast	+ 5.7	+ 7.7	+ 6.6
South Cent. ...	+ 3.5	+ 2.6	+ 5.0
Rocky Mount...	+ 8.5	+ 8.1	+ 6.1
Pacific			
NW	+ 6.0	+ 2.4	+ 0.5
SW	+ 7.0	+10.4	+10.2

Seasonally Adjusted Index 291

Week Ago 291 Year Ago 274

Source: Edison Electric Institute

Supply Lines

CLEVELAND TO OFFER TRADE-IN TO DISCOURAGE IDENTICAL METER BIDS

After rejecting five identical bids for 4,060 watthour meters, the city of Cleveland says it will try to get non-identical bids by asking that suppliers offer a trade-in allowance for some 400 old meters when they again bid on the 4,060 new meters. (See EW, April 17, p 16.)

GE DECLINES CASH SETTLEMENT AFTER CUSTOMER SHOWS NO PROOF

General Electric Co has declined a request by San Francisco officials to make a cash offer to settle alleged overcharging in electrical equipment sales between 1956 and 1960. At a 40-minute meeting held recently between city and company representatives, the city's stance, according to City Attorney Dion Holm, was that it "wanted to find out from them (GE) what they were willing to offer. We did not have any specific figure in mind."

The company's position was that after making a study of its electrical equipment sales to the city, there was no evidence to show the city had been overcharged. And since the city had no facts ready at the meeting to show otherwise, there was nothing to negotiate about, much less to make a cash offer on, a GE spokesman said.

GE was one of four companies the city asked to "come up with a fair offer" to repay alleged overcharging on equipment for the Cherry powerhouse at the Hetch Hetchy development. (Originally, the city said $6 million in sales were involved, but it has now cut the figures to $2 million by taking into account only equipment involved in "guilty" antitrust cases.) The other three are Westinghouse Electric Corp, Allis-Chalmers Manufacturing Co, and Federal Pacific Electric Co. City officials say these companies have not made their positions known yet on the cash settlement offer.

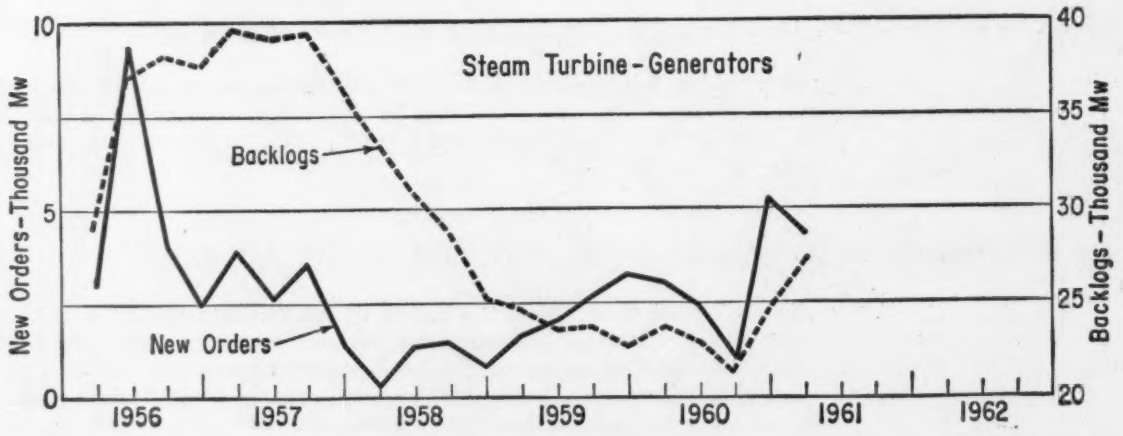
San Francisco says it will now sue GE for damages within a month, and also the other three if no settlements can be reached out of court. But the city has not decided yet whether to sue separately or join with the state attorney general in a comprehensive suit. Los Angeles has already decided to sue separately.

T-G PRICES RAISED; BACKLOG RISES; LOW MARKET PRICE REVEALED

Commonwealth Edison Co says it has ordered two 560-Mw turbine-generators from Westinghouse for $22,050,000, or $19.69/kw. No reason was given by the utility for announcing the purchase price. The first unit will be placed in service in 1965, the second in 1965 or 1966.

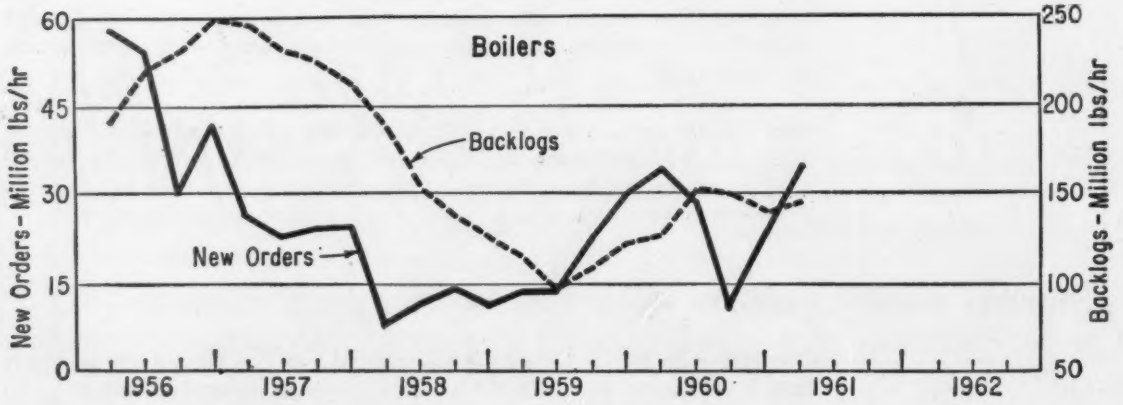
In another development, Allis-Chalmers announced last week that it had revised published prices of turbine-generators April 12, "based on recently completed design, engineering, and manufacturing costs studies." As with previous announcements on power transformers (EW, April 24, p 21; March 20, p 25), A-C says the new prices "are below previously issued published prices but above first-quarter 1961 market prices." It also notes that it intends to quote the new prices.

Finally, the Edison Electric Institute's just-published quarterly survey of the electric power industry shows that backlogs continue to rise for manufacturers of steam turbine-generators (see chart next page):



First-quarter new orders from domestic customers were 2,534 Mw, a little bit under the 2,913 Mw ordered in the same quarter last year, and well under the 4,758 Mw ordered in the fourth quarter of 1960. But manufacturers also received 1,879 Mw in export orders during the first quarter, so that total new orders were 4,414 Mw. The bulk of the export orders (1,783 Mw) are for five units for 1962 delivery to power-hungry Japan. During the previous five quarters new orders for export varied between 80 and 455 Mw.

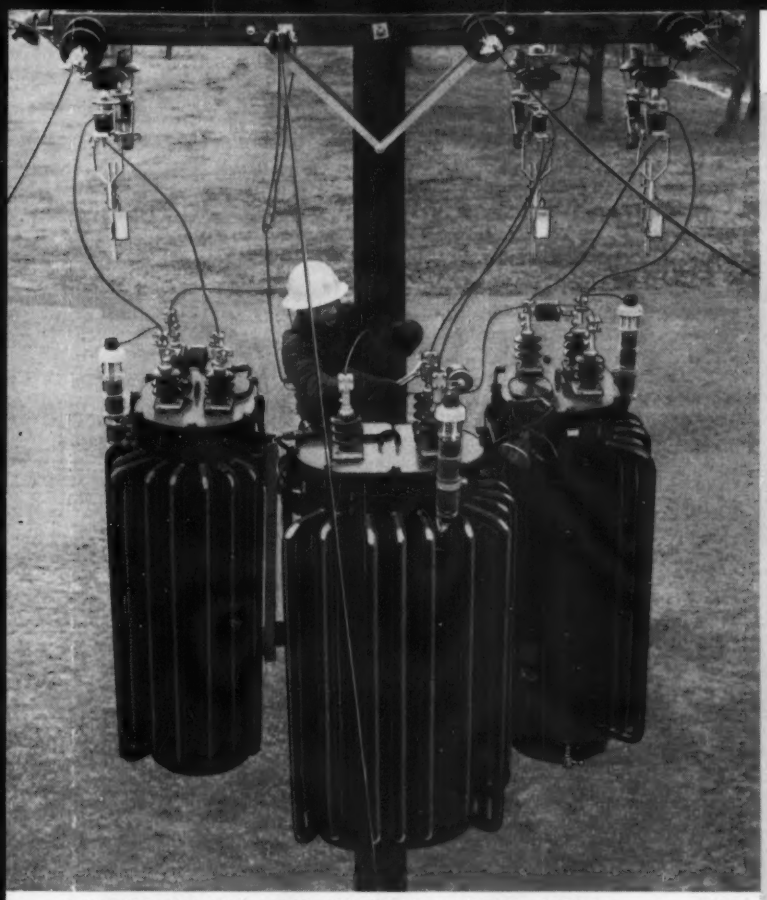
In boilers, backlogs also rose. First-quarter new orders totaled 34,825,000 lbs/hr of which 14,725,000 lbs/hr are for export.



PRICES CHANGED ON CAPACITORS, PRECIPITATION EQUIPMENT

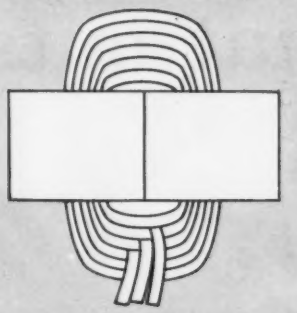
Capacitor published prices changed again last week. GE announced that on April 25 its new prices would be $110 for 50-kvar units and $209 for 100-kvar units. GE also changed the price protection period from 12 months from date of order to 90 days from date of price increase. Ohio Brass Co then announced that on May 1 its new prices would also be $110 for 50-kvar units and $209 for 50-kvar units in sets of two since it doesn't make capacitors in 100-kvar sizes.

In another move, GE changed prices April 17 on electrostatic precipitation rectifiers and transformers. Silicon rectifiers were reduced 5%; transformers for electronic tube rectifiers were increased 5%.

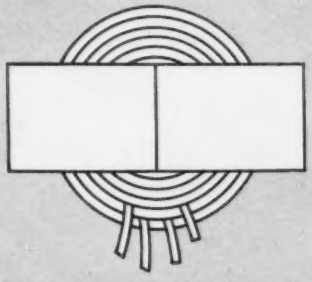


5,000 KVA OF LOAD REGULATED FROM A SINGLE POLE! Here, three L-M 219 ampere, 7620 volt regulators are cluster mounted to provide regulation on a 7620/13200 volt multi-grounded wye distribution feeder.

HIGHER SHORT CIRCUIT STRENGTH



OTHERS—competitors wind regulator coils in a rectangular shape. Mechanical forces induced by short circuit current tend to stress these windings into a circular shape. Rectangular windings are less able to withstand these forces.



L-M—incorporates the exclusive Round-Wound design. Coils are circular in shape and are naturally capable of withstanding higher short circuit stresses.

Regulate Up to 5000 Kva of Line Load With L-M's Cluster-Mounted Regulators

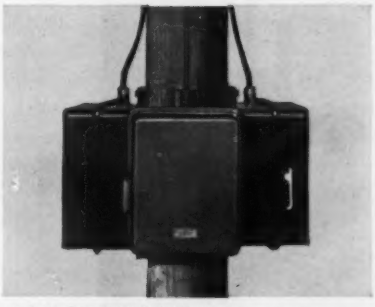
Compact Round-Wound® design cuts weight of L-M 32-step voltage regulators for low-cost cluster-mount installations; also provides exceptionally high short-circuit strength.

Line Material incorporates the exclusive Round-Wound design in all 32-step voltage regulators. As a result all regulators, with the exception of the largest size, can be either pole mounted or cluster mounted.

Now it is possible to provide regulation on lines in established areas where new construction is impossible. Cluster-mounted regulators not only save space, but also completely eliminate the real estate, construction, and labor costs associated with substation installation.

Get Complete Information

Your L-M Field Engineer will be glad to give you assistance and complete information on the application of L-M regulators. Or write Line Material Industries, P.O. Box 510, Zanesville, Ohio.



REMOTE CONTROL—L-M's control cabinet can be separated from the regulator tank. It may be mounted at any convenient location at or near base of pole. Connections between the regulator and the control cabinet are accomplished by a cable and connectors. Control cables and receptacles are available in a range of standard lengths.

OUR 50TH YEAR 1911 – 1961

LINE MATERIAL® Industries

McGRAW-EDISON COMPANY

Regulators

509-R

McGRAW EDISON

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Communication Cable
that cuts installation time

in half!

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I.M. CABLE

Cable messenger is firmly gripped between jaws of Tangent Support

- **Needs no separate messenger**
- **Requires no special hardware**

When you install SUPERIOR I. M. Cable, the need for spinning or supporting the cable to a separate messenger is completely eliminated!

Choose the core construction you need with color-coded plastic insulated conductors and longitudinally applied corrugated aluminum or copper shielding over the core tape . . . sizes 6, 12, 18, 25, 50, 75 and 100 pairs in 22, 19, and 16 gauge soft-drawn copper. Cable exceeds current industry specifications.

The messenger is impregnated with a corrosion-proofing thermoplastic compound which becomes an integral part of the cable configuration during the jacketing operation. Breaking strength exceeds 6000 pounds. Can be gripped, pulled and tensioned using standard techniques.

A high molecular weight polyethylene jacket is extruded over both core and messenger.

Install SUPERIOR I. M. Cable, supported communication cable, and save time and money!

For complete information and prices, write

SUPERIOR CABLE

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5358

New Westinghouse Loadbreak Cutout

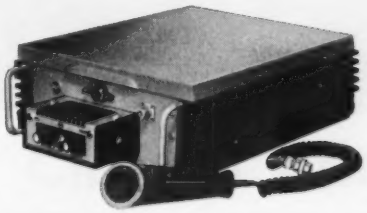
Wisely used transistors enhance the value of RCA "LD" 2-Way Radio and give it built-in dependability

In designing this efficient new "LD" equipment, RCA engineers wisely gave special consideration to the transistor. Only "stock" transistors capable of being serviced with existing test equipment and techniques are used—and only in circuits where they do the best job in cutting battery drain. Tubes are used where they can stand up under high temperatures, heavy voltages—jobs that tubes do best.

As a result the "LD" is not OVERtransistorized, is compact, yet accessible, miserly in power consumption yet value-packed to pack a punch in performance.

Leave the radio on when engine is off—battery drain is negligible. Use it on the roughest roads—transistors and sealed circuits give added assurance it can take it under gruelling conditions.

Specify the RCA "LD" and you can be sure it will stand in back of your endorsement. Lease or purchase plans available. RCA authorized service available. Ask your RCA Representative for complete descriptive literature. Or mail coupon below.



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☐ Please send me FREE literature on the new RCA Transistorized "LD" Mobile Radio.

☐ Have RCA Communications Specialist contact me and explain why this is today's best value in 2-way radio.

NAME_____ TITLE_____

COMPANY_____

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ADDRESS_____ PHONE_____

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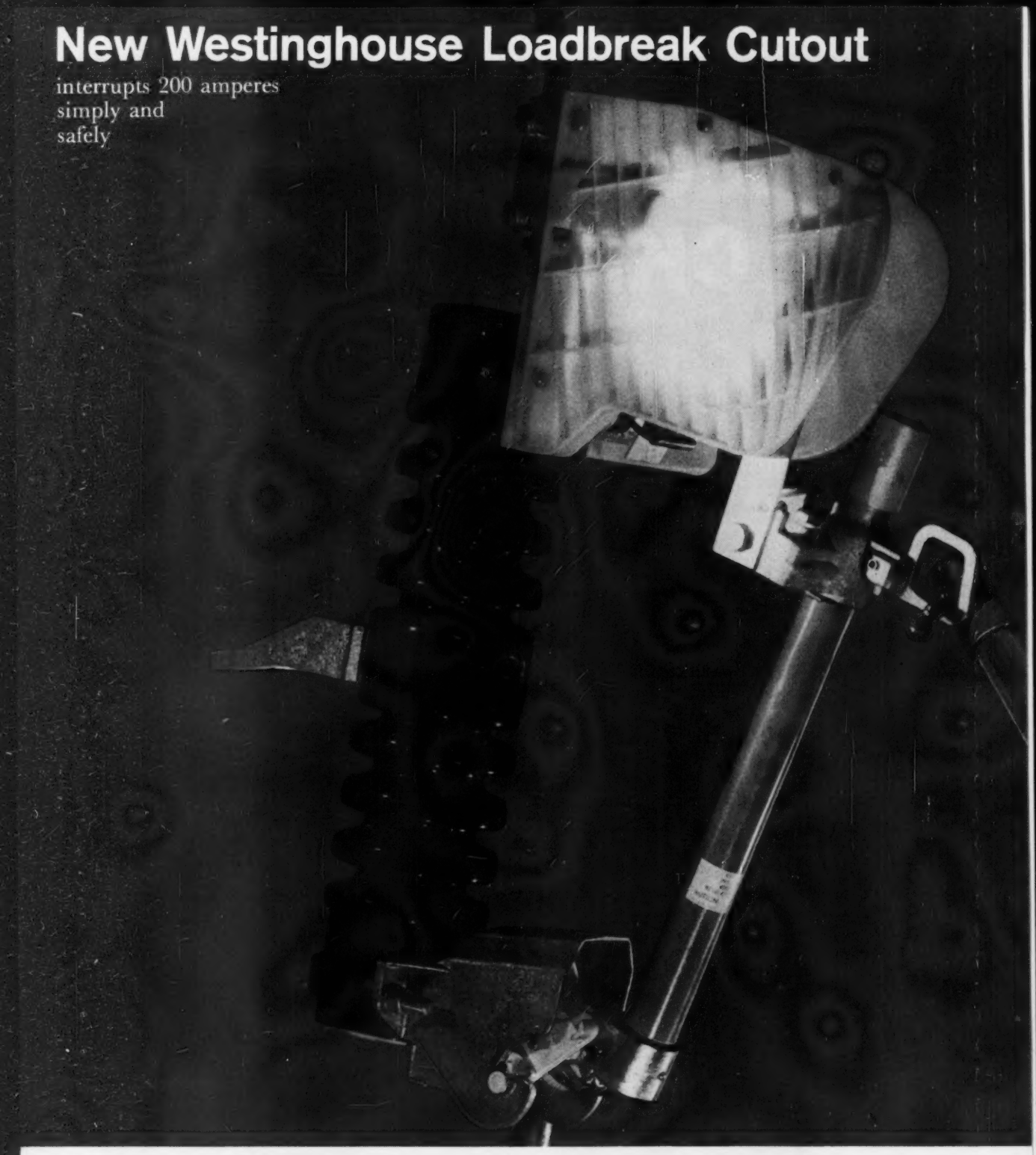
New Westinghouse Loadbreak Cutout

interrupts 200 amperes
simply and
safely



Open it safely

arc is confined within chute. The LBU is a self-contained cutout capable of breaking high load currents repetitively and is priced only $2.50 to $3.50 more than a standard open cutout. No special operating tools required; merely open in the conventional manner. No fuse link or gas bottle to replace—arc chute will last the life of the cutout.

Development of a new thermoplastic with exceptional nontracking quality, Delrin,* was the big arc-chute design break-through. When the blade is opened, a de-ionizing gas is generated from the thermoplastic by the arc heat. The gas, aided by the fast snap action of the blade, quickly extinguishes the arc within the chute, completing the simple yet safe loadbreak operation.

J-65000-1

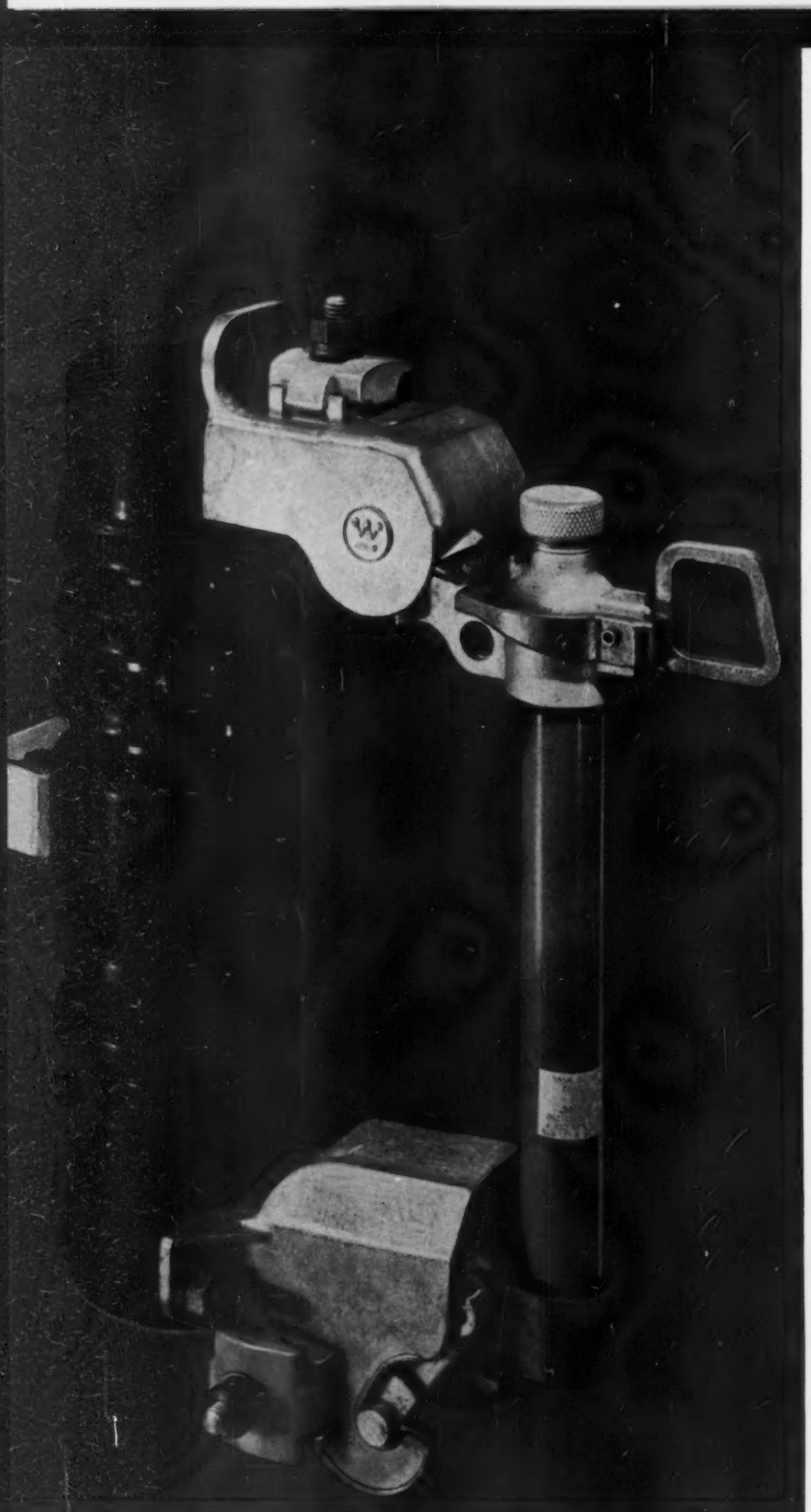
*Trademark of Du Pont

Close it simply

After 200 laboratory loadbreak operations, at full interrupting rating, with no maintenance, the arc chute showed negligible wear and only slight discoloration. The newly-developed thermoplastic arc chute has been completely tested, including ice test and accelerated weather test. Extremes of *temperature and sunlight* have no deteriorating effects.

also ▶

Trademark of Du Pont



Positive latching of the top contact, to prevent accidental opening. The cutout can only be opened by pulling down on the hookeye.

Cam action on the closing mechanism to reduce side-to-side movement when closing the cutout, yet to provide maximum clearance for rehanging fuse tube.

Spring loaded flipper, to help eject the fuse pigtail during a fault interruption and also to provide a positive latch for the bottom toggle mechanism.

Large wingnut with non-rotating washer and snubbing post, to clamp fuse pigtail with no slippage or fraying.

Heavy duty or extra-heavy duty service, for a wide range of fault current interruption requirements.

Tin-plated clamshell type terminals, suitable for aluminum or copper conductors from No. 8 to 4/0 ACSR.

Silver-plated contacts, to reduce temperature rise.

All parts made of non-ferrous materials, for long life under all atmospheric conditions.

LBU LOADBREAK FUSE CUTOUT RATINGS
15 KV—100 amp continuous current rating, with 200 amp loadbreak rating. (Equipped with an arc chute capable of interrupting 200 amp load at wide ranges of power factor.)

	NEMA Interrupting Rating RMS Asymmetrical Amps
Heavy duty, solid cap	4000
Heavy duty, exp. cap	8000
Extra heavy duty, solid cap	8000
Extra heavy duty, exp. cap	16000
Disconnect (200 Amp)	—

LDX OPEN FUSE CUTOUT RATINGS
100 amp continuous current rating

	NEMA Interrupting Rating RMS Asymmetrical Amps	
	7.8 KV	15 KV
Heavy duty, solid cap	5000	4000
Heavy duty, exp. cap	10000	8000
Extra heavy duty, solid cap	10000	8000
Extra heavy duty, exp. cap	20000	16000
Disconnect (200 Amp)	—	—

a new open cutout

On both the LBU Loadbreak and the LDX Fuse Cutouts, you get all the design features listed at the right.

For complete information, call your Westinghouse Sales Engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-65000-3

Westinghouse

A development of Orangeburg and Flintkote Research, new *klean-kote* Orangeburg Brand Fibre Conduit has a tough non-brittle protective coating for cleaner, safer handling. Ask your wholesaler to show you a length. klean-kote® **ORANGEBURG® BRAND *Fibre Conduit***

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You are looking at part of one of the fastest growing areas on earth: Los Angeles is the third largest U.S. city in population; the biggest in area covered.

The city itself has nearly 2.5 million inhabitants . . . spreads 50 miles north and south, 30 miles east and west . . . and is a center for making aircraft, electronic equipment, and sports clothes as well as motion pictures and dozens of other products.

But its fame rests on growth — fabulous, booming, American growth — in population and wealth.

Sustaining that growth are three trans-continental railroads which terminate there . . . and a large investor-owned and a municipal electric utility system.

Kerite, whose own history began in 1854, has played its part in this growth. And just as Los Angeles has kept faith in its future, so, too, has Kerite made its cable for the future — for the *permanent satisfaction of every customer . . . through dependable performance year after year.*

KERITE CABLE

it's the KERITE *that makes the difference*

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Editorial Comment

MAY 1, 1961

Texas and Southwest Pool Plans Applauded

Our March 20 editorial urged investor-owned utilities to take the initiative with imaginative interconnection plans which compete economically with possible federal alternatives.

Two plans, recently announced, certainly have seized the initiative; clearly, they are bold and imaginative. One (EW, Mar. 13, p 47), disclosed the week before our editorial, will lace major areas of Texas with some 800 miles of 345 kv. The other (EW, Apr. 17, p 50) will overlay or connect eight states of the Southwest Power Pool with "at least" 4,000 miles of 230 and 345 kv.

Thus we see concrete results of regional planning which strikes the shackles of individual-system sovereignty for the common good—and the ultimate benefit of the final customer.

The initiative thus taken should eliminate any government excuse for building additional federal transmission in these areas. As a clincher, we hope that line routing and capacities are such that common-carrier line use will be offered to any non-investor group at rates it cannot afford to reject.

Such aggressive action cannot help but impress Administration and Congress. The continued ability of the power companies to handle regional and interregional requirements at lowest cost and highest reliability, thus demonstrated, cannot be ignored.

The investor companies have done a good job in the past in this regard. A growing number now are showing their faith in the future of their industry and their service areas by extending this performance, taking full advantage of current economics and the latest in transmission technology.

The companies projecting the Texas and Southwest Power Pool plans are to be commended highly for their action to date.

Such farsighted planning, extended nation-wide, will strengthen the broad franchise of the investor utilities to serve their customers and their country.

Hanford Would Set Stage for More Federal Encroachment

Installation of some 700 Mw of electric generating capacity in the New Production Reactor (NPR) at Hanford would signal much more than a mere development of nuclear power. It could easily let down the floodgates to a whole new round of federal encroachment in the power field.

From our reading of the pertinent documents, it seems to us that Congressional approval of the Hanford power facilities would:

- Set a precedent for federally built steamplants outside the Tennessee Valley.
- Add support to the argument that the federal government must assume a utility responsibility in areas where it operates hydro projects.
- Set up a situation in which federally constructed transmission interties become much more plausible.

Thus the Kennedy Administration's urgent interest in gaining Congressional approval of the Hanford power facilities becomes more apparent. If it can win on this one, then it has set the stage for a much broader federal role in power development and transmission.

In its budget review message sent to Congress in late March, the Administration requested $60 million to begin work on the Hanford power facilities. The Joint Congressional Committee on Atomic Energy was to begin hearings last week on a hastily drawn bill to authorize these power facilities.

In a full-page editorial last week, we suggested a number of questions that should be answered in connection with the Hanford power proposals. We believe there is too much broad power policy involved to permit them to sail through without full debate.

Kefauver After Higher Echelons

Four former General Electric executives testify that orders for price fixing meetings came from higher up

Four General Electric Co executives who left the company in the wake of the government's price-fixing charges against the electrical equipment industry have told a Senate subcommittee they were ordered to meet with competitors by officials higher up the GE ladder.

Testifying before Sen Estes Kefauver's (D-Tenn.) Antitrust and Monopoly Subcommittee last week were: George E. Burens, vice president and general manager of the switchgear and control division; Clarence E. Burke, general manager of the high voltage switchgear department; H. Frank Hentschel, general manager of the medium switchgear department, and Frank E. Stehlik, general manager of low voltage switchgear department.

Tell of Meetings With Competitors

The four former GE executives told of numerous meetings with other competitors in the electric equipment industry to fix prices and allocate markets, and asserted that meetings in GE's switchgear division, at least part of the time, were held because top management insisted on them.

The name of Arthur F. Vinson, vice president and group executive of GE, came up most. Vinson, who has denied participation in any illegal activities, was originally named in one of the 20 government indictments against the companies. But after an investigation by the FBI and the Justice Department the indictment against him was dismissed.

At Tuesday's hearing, Kefauver said Vinson had been subpoenaed the previous midnight to appear before the subcommittee.

Burens, who started with GE in 1921 as a 33-cent-an-hour stockboy, said he was introduced to meetings with competitors after he came to the switchgear division in 1951. He said his predecessor, R. F. Tinnerholme, was known as "Mr. Switchgear" to the industry and felt, said Burens, that "meeting with competitors was the only way the business could be operated."

Burens said he objected to these meetings but was approached by Henry Van Erben, then executive vice president in charge of the apparatus group (a position corresponding to Vinson's current job), who "wanted to be sure I was indoctrinated." Van Erben, said Burens, "told me he went to Cordiner (Ralph J. Cordiner, GE chairman) and said, 'I asked him not to ask me to stop doing it (meeting with competitors). And if he did not ask me he would not hear about it.'"

Cordiner, after hearing of the statements, said "It is an outrage to suggest that I in any way knew of or condoned violation of antitrust laws. Any charges to this effect are false. My turn to testify, I hope, will come in due course, and I will answer any allegations, no matter how remote or second-hand they may be."

Later, said Burens, after the 1954-55 "white sale" in the industry, Van Erben's job was taken by Robert Paxton, later president, but now retired. "Van Erben said to me," Burens said, "'George, your competitors are complaining that you won't meet with them; won't cooperate with them.' I laughed and told him he wasn't my boss any more." Van Erben, who died several years ago, then went to get Paxton, who told him that an official of Cutler-Hammer Co wanted to meet with him, Burens said.

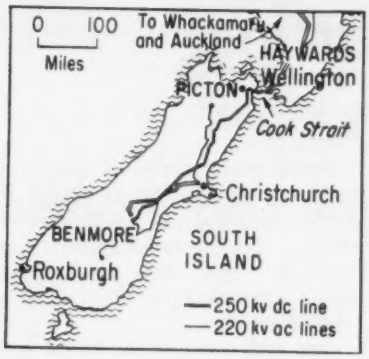
Purpose of this meeting, said Burens, was to "stabilize prices by getting together with competitors and deciding what prices would be." He said he also "understood" that markets had been allocated for "many years," by companies keeping track of who had had the last award on sealed bid contracts. He said there was no allocation or price-fixing on other than sealed bids, which amounted to about 10% of the switchgear business.

Burke said he was introduced directly to price-fixing when he went to GE's transformer division in Pittsfield, Mass., in 1945. He said he recalled one instance in which the transformer division was being pressured to eliminate inventories under orders of Paxton, then its manager. Burke said he objected because products were shelf items, and a complete reduction would mean that competitors would have an advantage. "He then suggested that we get them to get their stocks down the same way we got them to agree on prices," Burke said.

After he became manager of his department, Burke said, his principal connection with the meetings with competitors was to "break impasses." The bulk of such duties fell on subordinates. In late 1952, he said, Westinghouse and GE were unable to agree who would be low bidder on a 345-kv breaker for the Atomic Energy Commission's Portsmouth, Ohio, plant. "It was a new product," Burke said, "and both GE and Westinghouse were eager to get the first job for the prestige." He met with Landon Fuller, a Westinghouse executive, "but we couldn't reach an agreement." He said he reported this to Burens and understood Burens reported the impasse to Van Erben. Later, he said, he was told to quote 3% under book price for the job, "and you'll get it." Burke added, "that's the way it worked out."

Meetings Resumed by Order

The four former GE executives gave similar descriptions of a time in 1958, when, they claim, Vinson came to the switchgear division's headquarters in Philadelphia to order that price-fixing meetings be resumed. Vinson denies he attended this meeting or that he gave such an order. The witnesses said they attempted to corroborate their story of the session after it became evident that GE officials were denying it took place—and after they had left the company—but found records were not available to them. Burens, Burke, Hentschel and Stehlik asked for lie detector tests by the FBI. The tests indicated they were speaking truthfully of the session. Vinson, according to Kefauver, declined to take a test.



Submarine Cables to Link Islands of New Zealand

Submarine cables, to span the Cook Strait in New Zealand, and, on the other side of the world, to link Sweden with the European mainland, are in the planning stage.

Cook Strait is about 25 miles wide and separates the northern island of New Zealand from the southern island. The European connection would join Sweden to Helsingoer, Denmark, just north of Copenhagen. From here, either it would run west, connecting to the Isle of Fyn by a second submarine cable, and then into Jutland, or it would run south, using submarine cable to reach Fehmarn island, north of Hamburg.

In New Zealand, power would come from the Benmore hydro-electric station now being built on the Waitaki River in the south island. When completed in mid-1965, the station will generate 450 Mw. Consultants have recommended a 500-kv, dc line, including a segment of submarine cable, to share this power with the northern island. From Benmore to the submarine cable head at the southern shore of Cook Strait is a distance of 335 miles. An additional 25 miles of line would be needed on north island. Estimated cost is $52.5 million.

The Sweden-Denmark cable was proposed by a group of West German electric utilities, and is presently awaiting approval by leading Scandinavian power-supply corporations. The purpose of the link is to allow Sweden and Norway to export their surplus hydroelectric power to Europe during the longer rain and thaw seasons. During the dry season, Scandinavian utilites would receive power from West Germany's coal-burning stations.

SoCalEd Files Proposal For 360-Mw Atomic Plant

Southern California Edison Co, Westinghouse Electric Corp and Bechtel Corp have filed a consolidated firm proposal with the Atomic Energy Commission to build a 360-Mw pressurized-water power reactor. Under the proposal, Westinghouse is asking for $11 million in government research-development assistance.

Edison wants to locate the reactor on a 90-acre tract inside the Camp Pendleton, Calif., Marine Corps base. So far, the Marines have opposed any lease of the Pendleton land which would bring anything other than Marines inside the base.

AEC has asked the Navy to help out in clearing the Pendleton site for use by Edison, but the site problem for the big nuclear power plant has not been resolved.

Sen Clinton P. Anderson of the Joint Congressional Atomic Energy Committee says that he will help get the Pendleton site for Edison. A joint campaign by AEC and Congress to break down the Marines' resistance to the reactor being located on Pendleton soil may now be expected.

FPC to Rule on Expanded Nez Perce Application

The Federal Power Commission is expected to rule on the Washington Public Power Supply System's attempt to expand its application for the Nez Perce project on the Snake River to take in the High Mountain Sheep location sought by Pacific Northwest Power Co.

Mrs Evelyn N. Cooper, attorney for WPPSS, unveiled the System's new approach in FPC hearings before Examiner William C. Levy.

She asked Levy to permit WPPSS to amend its application for Nez Perce to also include a High Mountain Sheep project. WPPSS still considers Nez Perce superior, she said, but she asked that amendment be permitted to provide an alternative for WPPSS if Nez Perce should be denied.

Mrs Cooper said WPPSS proposes "A different project . . . a different layout" for High Mountain Sheep than Pacific Northwest Power.

Levy recessed the hearing for a day to allow the parties time to prepare positions on the motion. He intends to rule on it himself, since it was addressed to him, but he said at mid-week that he would probably need time to study the arguments.

Regardless of how he rules, one of the parties is certain to appeal his decision to the full FPC.

Manitoba Integrates Two Agencies Into New Utility

Two Manitoba government agencies concerned with the generation and distribution of electric power have been combined into a single utility, Manitoba Hydro.

The Manitoba Hydro-Electric Board, formerly responsible for power generation in the province, and Manitoba Power Commission, which was in charge of power distribution outside the city of Winnepeg, are officially integrated.

D. M. Stephens, former chairman of the Hydro Board, became chairman of Manitoba Hydro, and W. D. Fallis, who was Power Commission general manager, was appointed general manager of the new unit.

The purpose of the organization, created by legislative act, is " . . . to provide for the continuance of a supply of power adequate for the needs of the province, and to promote economy and efficiency in the generation, distribution, supply and use of power."

The act stipulates that corporate affairs shall be administered by a board of not more than seven members appointed by order-in-council.

Under the old system, three utilities were linked into an integrated system with defined areas of responsibility. The Hydro Board was primary generation and transmission agent. City Hydro, with two power stations on the Winnepeg River and one small thermal station in Winnepeg, supplied Winnepeg requirements. The Power Commission bought from the Board and distributed to the suburbs and rural Manitoba.

Manitoba has interconnections with Saskatchewan to the west and Northwestern Ontario to the east, assuring emergency supply.

Utilities Ahead in State Battles

Utilities fared fairly well in their battles in the 1961 state legislature sessions. And, in public vs investor-owned power hassles, investor-owned power forces appear to have done slightly better than their public power opponents.

In North Carolina, the state legislature, which is still in session, killed a bill which would have altered the method used by the State Utilities Commission to fix rates of public utilities.

The law states that the commission shall take into consideration "fair value" of the utility's property and give rates that will provide a fair return on that valuation. The bill, quashed by a unanimously unfavorable report of the Senate Public Utilities Committee, would have directed the commission to use original cost less depreciation to get a value for the property.

Utility spokesmen had opposed the bill on the grounds that it would result in higher rates rather than lower, as contended by proponents.

A rate-base bill introduced in Missouri's legislature was also killed. The measure would have required the Public Service Commission to use original cost of a utility's property to determine rate base. A Missouri Supreme Court decision requires the commission to determine rate base by considering original cost, reproduction cost, present economic conditions, and any other revenue point.

Opponents contended that use of original cost would give results, in periods of deflation and depression, that would be unfair to the consumer, just as the results in inflationary times are unfair to the utilities.

The fate of the bill, killed by the House Judiciary Committee at an executive session, was identical to that of a similar bill in the last legislature.

In the Northwest, public and investor-owned power forces waged a tug-of-war which resulted in a major investor-owned power victory in Oregon and roughly a draw in Washington.

Public power forces in Washington were able to secure passage of only minor legislation during the '61 session, but were successful in blocking a bill which would have forced condemnation matters to a vote of the people.

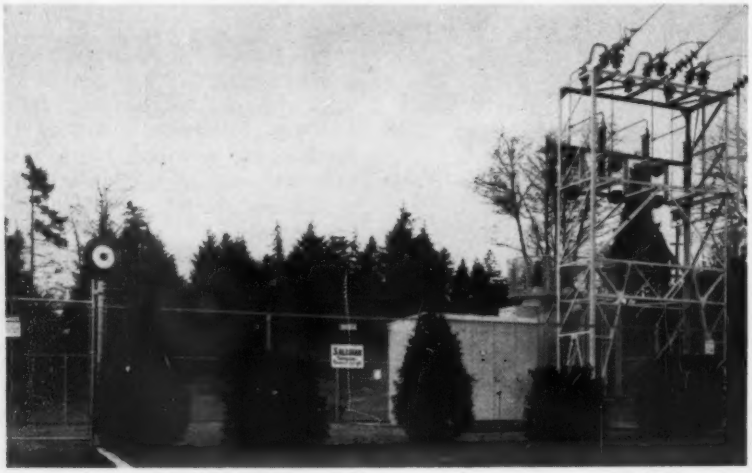
One new law permits PUDs and other public agencies to invest surplus savings in savings and loan associations and short-term federal securities. The state attorney general recently pointed out that the practice, long a common one, is illegal without statutory authorization. Another law provides for retention of established employee benefit programs when an investor-owned utility is acquired by a PUD.

In Oregon, investor-owned power men scored a major victory when the state House of Representatives defeated a bill to let PUDs issue revenue bonds without authority of the district's voters. Washington PUDs have had a free hand in issuing revenue bonds since 1931, a factor in the extensive growth of PUDs in that state (now 24). Oregon PUDs have always been limited (there are four in that state).

Also in Oregon, Governor Mark Hatfield recently signed into law a 1961 legislative act abolishing the Oregon Hydroelectric Commission and transferring to the state engineer its function of acting on hydro project applications.

Three pieces of utility legislation that failed in Kansas are:

- A bill to restrict municipals from encroaching on co-op and investor-owned territory outside city limits without a certificate from the state corporation commission. This bill was remanded to a legislative study group. A report on it could be brought in in two years.
- A proposal to return to original cost for rate-making. Fair value is now the law.
- A bill which would have given municipal utilities the right of condemnation outside city limits. This is necessary if the municipals are to build their interconnections and if Southwest Power Administration is to sell power to the proposed interconnection (EW, Mar. 13, p 46).



Rock-Flinger, Spare That Insulator!

Rock-throwing boys have been provided with a substitute target for substation insulators, their favorite past-time.

Tacoma City Light made the target (upper left) out of the end of a steel oil drum and painted it brightly. Between its brightness and the noise made when hit, the target is proving an adequate distraction to the mischievous lads. Before installation, about an insulator a week was broken. Three months later there was no insulator breakage yet reported.

- Representatives of utilities and government agencies talk
- Work group of 17 representatives is formed to implement plan
- Smaller policy group will have general control of negotiations

NW Coordination Plan Moves Ahead

Top management representatives of non-federal generating utilities of the Columbia Basin in the US and officials of the Bonneville Power Administration and the Corps of Engineers have started procedures toward a new and more comprehensive coordinating agreement for Columbia Basin power generation, transmission, and hydraulic management.

The proposed coordination agreement (EW, Mar. 20, p 52) would extend beyond the present Northwest Power Pool arrangements.

Touched off by considerations which will have to be met if Canadian storage and necessity for a return flow of power to Canada develops, the idea of an agreement was expanded at suggestion of Secretary of Interior Udall to cover other areas as well.

The meeting was called by Bonneville Administrator Charles F. Luce and Maj Gen Alfred D. Starbird, North Pacific Division of the Corps of Engineers.

General Scope Stated

The group stated a general position on the scope of the proposed coordination agreement.

Such an agreement should not, it said, "contemplate the pooling of capital investment in power facilities or the control of operations of all parties by a single entity, but should contemplate the sharing of costs of reservoirs.

"The group believes that an agreement should contemplate coordination of reservoir releases on a seasonal and monthly basis through advance cooperative planning and the interchange of energy to assure each party of a guaranteed firm load carrying capability and to assure the optimum firm load carrying capability and usable secondary energy for the area as a whole," said the group's statement.

Areas to be considered were divided into two categories—those on which considerable progress toward securing benefits of coordination has been made and those listed as "recognized problem areas . . . not yet fully explored or resolved."

Listed under the "considerable progress" heading were:

Diversity of streamflows, cooperative programs of reservoir release, diversity of loads, cooperative scheduling of maintenance outages, cooperative use of available reservoir space, exchange of energy to carry firm loads and for storage of excess energy, cooperative sharing of dependable capacity losses as individual projects due to Canadian storage, and cooperative sharing of the United States obligation to return power and energy to Canada.

Included among the "problem areas" were:

The method of handling the use of thermally generated energy, coordination of pondage operations, cooperative use of transmission facilities, coordination of peaking capacity, reconciliation of existing contractual obligations, legal limitations on the parties, the problems of interregional systems, and limitations opposed by non-power uses.

The work group will delineate the scope of the agreement with specific attention to areas that are to be included or excluded. It will designate task forces and formulate task force goals.

AEC Loosens Operating License Control

Private nuclear reactor operators are getting their operating licenses broadened by a new rule of the Atomic Energy Commission.

The AEC-regulated reactor operators previously were not permitted the latitude to make changes, unless terms of their operating licenses explicitly allowed it. Now all non-government reactor operators are to benefit by increased freedom in which to run their reactors for power, commercial materials testing, teaching purposes, etc.

The proposed rule will also eliminate scores of regulatory hearings before the Commission and reduce the burdensome paperwork involved in such proceedings.

Here's what the rule will allow reactor operators to do:

- Make changes in the entire reactor facility, in its operating procedures and conduct experiments and tests—unless they involve a change in the reactor's technical specifications or involve an "unreviewed safety question."
- Operators must contact AEC if a proposed change, test or experiment involves a change in technical specifications or an unreviewed safety question. They may not proceed unless authorized by AEC. (If operators are in doubt as to whether technical specifications or unreviewed safety questions are involved, they must always contact AEC in these doubtful cases.)
- The operator must submit to a formal safety hearing if the Commission finds significant new hazard considerations in proposed changes. The question, in these instances, will also be submitted to the Advisory Committee on Reactor Safeguards for a report.

The new AEC rule stems from an almost identical order which was granted General Electric for its Vallecitos, Calif., test reactor last fall.

All interested parties have until July 27 to submit their comments and suggestions on the rule to AEC. After July 27, AEC will consider a staff proposal and recommendations (which will take into consideration public comments) and then place the final rule into effect.

Systems Must Jump Boundaries

EEI Pres Sherman Knapp tells Southwestern Electric Conference industry must recognize integration needs

Utility boundaries set originally by politics, geography and corporate limits must now be jumped by efforts to intensify electrical system integration. Refusal to recognize this need is a disservice to the industry, according to EEI President Sherman Knapp.

The Connecticut Light & Power Co chief threw these flat assertions directly at the 88 utility top executives attending the recent Southwest Electric Conference at Chandler, Ariz. But even as he spoke, headquarters of 11 of the 30 utilities represented were announcing their participation in a 4,000-mile, eight-state EHV grid plan for the Southwest Power Pool (EW, April 17, p 50).

The bulk of the other utilities attending the Conference are located in areas bordering that served by the proposed 230/345-kv network. Thus an aura of excitement and high-level discussion was easy to sense among the presidents and top aides present. In fact, pooling and interconnections as a discussion topic rivaled other favorites, politics and antitrust damages.

Old Boundaries Are Gone

Early in utility history, Knapp told the Conference, utility corporate boundaries matched political and geographical boundaries. But today there is little relationship among the three which makes sense with respect to planning and operation of economical power systems.

In his own Connecticut Valley, Knapp said, where the system integration concept is considered well advanced, one company already is installing units treble the size possible without strong interconnections. But he refused to consider the job finished, visualizing the day when the entire New England region operates electrically as though it were a single-company system, with possible extensions into neighboring regions as well.

Rate matters came in for their share of consideration.

An outspoken regulator, George Perrine of the Illinois Commerce Commission, decried the fact that politicians are prone to use rate matters for political purposes, but he laid much of the blame on the "uneducated press." Following a recent public blast to this effect, Perrine said he had the opportunity to sit down with influential Illinois newspapers to explain his position. The net result, he reported, was that these papers now assign top grade, informed business reporters to cover rate cases and attendant publicity.

SHERMAN KNAPP

Perrine acknowledged that the Illinois body was plagued with the same over-workload of rate cases as other regulatory bodies. But he said inroads on the backlog are being made by adoption of two approaches. The first is the admission of "canned testimony" filed prior to hearings. The second is the acceptance in Illinois of fuel adjustment clauses in residential rate schedules. The impact of the latter has been stronger in gas cases, but many residential electric rates also now have such provisions.

Perrine stated that Illinois fuel clauses work in either direction; where FPC readjustment of preliminary interstate pipeline rates has reduced costs retroactively to gas distributors, the customer has benefited automatically under the clauses.

A proposal for a nationally organized, top-level arbitration council for settling utility labor disputes when local negotiations fail was advanced by Gordon Freeman, president of the International Brotherhood of Electrical Workers. Such a method has been used successfully for 40 years between the IBEW and members of the National Electrical Contractors Assn, according to Freeman, who saw no reason why some adaptation of it could not be made for utilities.

In the IBEW-NAEC approach, six representatives from each national body accept disputes between locals and contractors where local arbitration has failed. Provision for council arbitration is written into many of the contracts, Freeman said. For action to be binding, the 12 representatives must be unanimous.

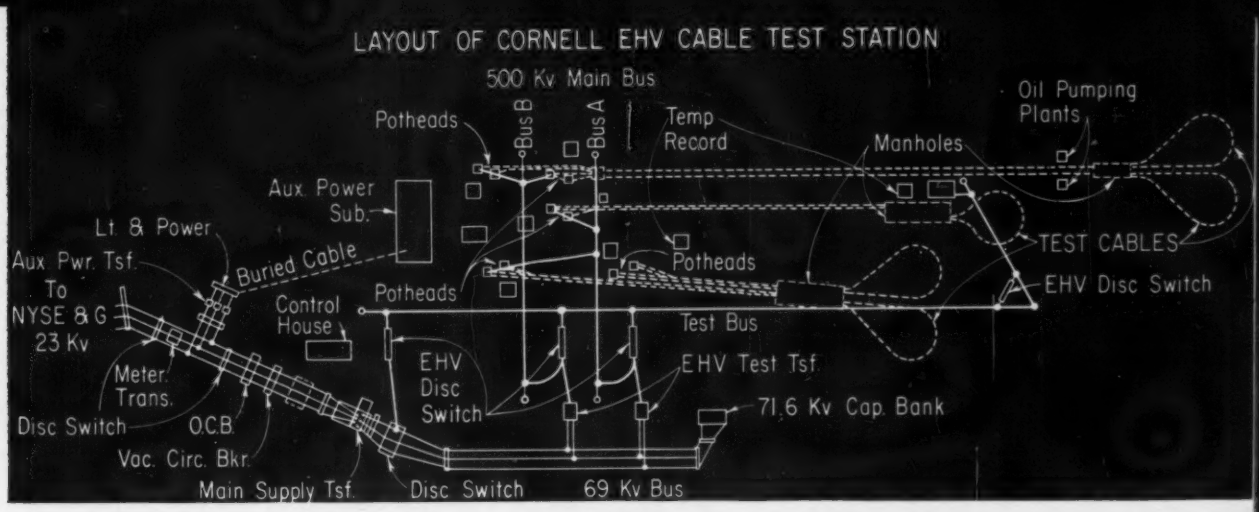
The IBEW chief suggested consideration of the approach for utility labor disputes on the premise that it would help to prevent government interference without outlawing strikes by utility workers.

Recession Has Ended

The short, mild recession of 1960-61 has bottomed out as inventories have been brought into balance with sales in an increasing number of industries. This was the theme of a detailed presentation by Martin Gainsbrugh, chief economist of the National Industrial Conference Board, one of the chief propounders of the inventory orientation of the current recession. "This was a capital goods recession," Gainsbrugh emphasized, noting the upward climb of expenditures for services all during the downturn.

But the economist sounded a warning: mild recessions historically have been followed by equally mild recoveries, and this one is no exception. In fact, the upturn may be of inadequate strength to keep pace with the rapidly expanding labor force. Gainsbrugh prescribed business tax reform to boost national economic growth enough to accommodate the influx of newcomers to the labor market. Without employment of this group, he said, the potential of the "Golden Sixties" cannot be realized.

EHV Cable Systems *(Continued)*



EHV Cables Are Field Tested at Cornell

Pipe-type and self-contained cable systems, complete with joints and potheads, begin three-year program of load and stability tests; cable tests are jointly sponsored by AEIC–EEI and manufacturers

■ Today at the Cornell EHV Cable Testing Station a three-year program of field service tests is under way on a group of four 345-kv underground cable systems in an effort to evaluate the electrical, thermal and mechanical performance and stability of modern paper-and-oil cables under operating conditions prevailing on actual power systems.

The field test program is a direct result of the growth in overhead transmission at 345 kv in the US today and the increased use of turbine-generator units of 350 Mw and larger. Both these trends have emphasized the ultimate need for higher-capacity underground cable systems. The Cornell cable tests have been undertaken to confirm the ability of modern conventional cable designs to transmit 500 Mva at 345 kv and higher without serious increases in power factor or dielectric losses over long periods.

The four 345-kv cables undergoing test are of different design. They range in length from 600 to 1,000 ft and were developed and contributed to the test project by the cable and accessory manufacturers.

Two of the test cables are high-pressure, oil-filled pipe-type cables. The remaining two are self-contained oil-filled cables; one a high-pressure aluminum sheath design, the other a low-pressure lead sheath design.

During the next two years the cables will be subjected to cyclic loading at conductor temperatures up to 90C, comparable with commercial operating conditions. Power factor stability measurements will be taken on cable sections, potheads, and joints up to and above 400 kv. In the third and final year of tests, cable temperatures will be raised and voltages increased beyond rated limits to evaluate ultimate capability of the cable circuits.

Load is applied to the cables in cycles of 32 hr "on," 16 hr "off." Loading transformer in the form of "doughnuts" are mounted on the cable risers below the potheads on each test cable sample. Each doughnut is capable of inducing current in the test cable sample of 100-125 amp when energized at 240v, thus inducing 6v in the test cable. For maximum cable loading of 2,000 amp, 17 to 20 loading transformers per test cable were provided. Capacitors maintain load power factor at 80% at 2,000-amp load in cable samples. Demand is 180 kva.

Pipes for the pipe-type cables are in parallel with a 4-ft separation and have common manholes. Two joints are in each cable, both normal joints. Loops at the end of the pipe were tinned copper pipe for the Oilostatic cable, carbon steel for the other. Riser pipe was copper and stainless steel for the two cables. In both cases line pipe is bare.

Separate duct systems were built for the two self-contained cables. Two spare ducts were built. Both joints in the high-pressure oil-filled cable were normal joints. But in the low-pressure, oil-filled cable one normal and one stop joint were installed. The stop joint operates without pressure differential. The loop enclosing the HPOF cable is a 6-in. plastic duct split horizontally so the comparatively stiff aluminum sheath cable could be laid without damage.

Three of the four cables have capacitor-graded potheads of slightly different design and manufacture at each end. The fourth (LPOF) has a non-graded pothead on one terminal and a graded pothead on the other.

Power supply for the tests, taken from the 23 kv system of New York State Electric & Gas, is stepped up to 69 kv in a main supply transformer and connected to two of the Tidd main test transformers which have been re-rated 4,500 kva at 300 kv to ground. A 69-kv capacitor bank balances kvar load among phases.

Details of the cable and pothead designs are given in the accompanying articles.

Tin or Lead Coat Cable's Copper Components

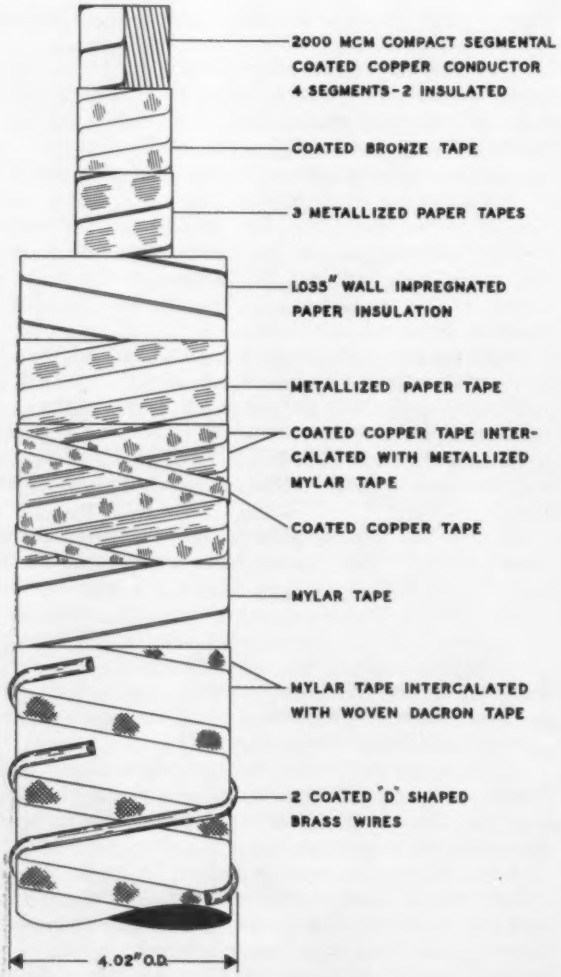
R. B. **BLODGETT**, Manager, Paper Cable Research

R. C. **WALDRON**, Manager, Engineering, Okonite Co, Passaic, N.J.

■ The cable supplied by the Okonite Co to the AEIC-EEI EHV-cable research project at Cornell is basically a high-pressure, pipe-type cable with oil as the pressure medium. Materials in the insulation and construction of this system varied somewhat from those now used for this type cable and were chosen on the basis of extensive studies involving more than 500 model cable tests.

But the design of the project cable differs from that of a commercial product suitable for the same voltage only through the addition of insulating tapes between the shielding and the D-shape wire armor. This addition was for convenience in measuring dielectric properties. This cable system differs from present-day practice at lower voltages in several important aspects.

Coated copper strands were used for the conductor as well as coated shielding tapes, D-shaped wire, and internally coated copper pipe for the riser sections and the end loop. The coatings were either tin or lead alloy, extensive tests having indicated that the catalytic action of the metal was less severe with either tin or lead than with copper.


2000 MCM COMPACT SEGMENTAL COATED COPPER CONDUCTOR 4 SEGMENTS-2 INSULATED
COATED BRONZE TAPE
3 METALLIZED PAPER TAPES
.035" WALL IMPREGNATED PAPER INSULATION
METALLIZED PAPER TAPE
COATED COPPER TAPE INTERCALATED WITH METALLIZED MYLAR TAPE
COATED COPPER TAPE
MYLAR TAPE
MYLAR TAPE INTERCALATED WITH WOVEN DACRON TAPE
2 COATED "D" SHAPED BRASS WIRES
4.02" O.D.

CABLE NO. 1—Okonite sample has coated copper strands for conductor and coated shielding tapes, D-shape wire, internally-coated copper pipe for riser and end loop

Copper Affects Oil Properties

Although it has been known for many years that copper has a catalytic effect on the dielectric properties of oil, the effect in most instances results in little change in the over-all cable characteristics. In this 345-kv cable, the dielectric loss is a large part of the total loss permitted from the cable, and any increase in this dielectric loss would result in a necessary reduction in the system's load capability.

Lower-density, wood-pulp paper was used instead of the high-density papers now normal. The lower density paper gave the cable a lower dielectric loss and a lower electrostatic capacity. Dielectric losses are directly proportional to both capacity and the dissipation factor. Through use of the low-density paper, the insulation's specific inductive capacity is reduced from a value of 3.8 to 3.25, resulting in a 15% decrease in dielectric loss. A further decrease of 30% in the dielectric loss was brought about by lowering the dissipation factor from 0.3 to 0.2%.

These decreases incurred some sacrifice in thermal conductivity through the insulation and, possibly, some lessening in impulse strength. Yet the impulse strength of the wall thickness is more than adequate for the specified BIL. The cable, together with the joints and terminals, withstood 1,300 kv without failure on impulse testing.

With this type paper on thinner-walled samples, actual breakdown values under impulse indicated an ultimate breakdown value in excess of 1,750 kv, which is greater than the flashover values of the terminals.

Thinner Paper Had No Advantage

As studies failed to demonstrate that the thinner papers had any advantage in such oil-impregnated pressure cables, regular thickness papers were used in this cable, the thinnest being 5 mils.

The cable was impregnated with a polybutene oil, which has better aging characteristics than napthene-base oils. The viscosity was essentially the same as that of oils used for impregnating pipe-type oil-pressure cables now. Not only is the aging of the oil by itself better than a napthene-base oil but in contact with metal less deterioration results. For filling the pipe, a lower viscosity polybutene oil was used, this oil being more stable than the napthene-base oils that have a similar viscosity.

The cable joints were made in accordance with present standard practice, except that the crepe paper was free of additives normally used for creping. The joint's longitudinal stress was based on 5 v per mil, and the

EHV Cable Systems *(Continued)*

slope of the taper along the original insulation and on the outside buildup was designed to maintain a uniform longitudinal stress along this surface for the length of the joint.

Extensive tests on cable samples preceded installation at Cornell, cable and joint being subjected to impulse testing up to 1,300 kv. The usual tests were also applied to them and to the terminals. These ac tests included 6 hr at 375 kv, 10-sec at 550 kv, and 1-min at 680 kv.

Another sample, subjected to the standard AEIC high-voltage time test, withstood 6 hr at 352 kv, followed by 24 hr at 445 kv. Following this, the same sample, with its joint, was then subjected to heat cycling for longer than two months. Temperatures were as high as 110C. The heat-cycling tests were made with 260 kv applied between the conductor and the shield. No change was observed in the power factor-temperature curve of the cable during the test.

Following the successful tests on the laboratory lengths of cable, the remainder of the cable manufactured at the same time was installed at Cornell in accordance with the commercial practice of installing pipe-type cable. The pipe was installed, evacuated, and dried by the prevailing method. The cable was then pulled in and spliced. Preliminary tests then gave power factor values agreeing with those obtained in the laboratory.

The author and his associates believe that this cable will remain stable, operating under the proposed tests at Cornell without appreciable change in electrical characteristics.

Cable Design Eliminates Copper-Oil Contact

M. H. McGRATH, Vice President and Chief Engineer, General Cable Corp, New York, N. Y.

■ General Cable Corporation's decision to furnish a high-pressure oil-filled, pipe-type cable for the 345-kv Cornell field tests was predicated on three primary objectives: **(1)** Mechanical ruggedness of the system as a whole and mechanical ruggedness and uniformity of the cable in the system, **(2)** Low initial insulation power factor, **(3)** Stable insulation power factor.

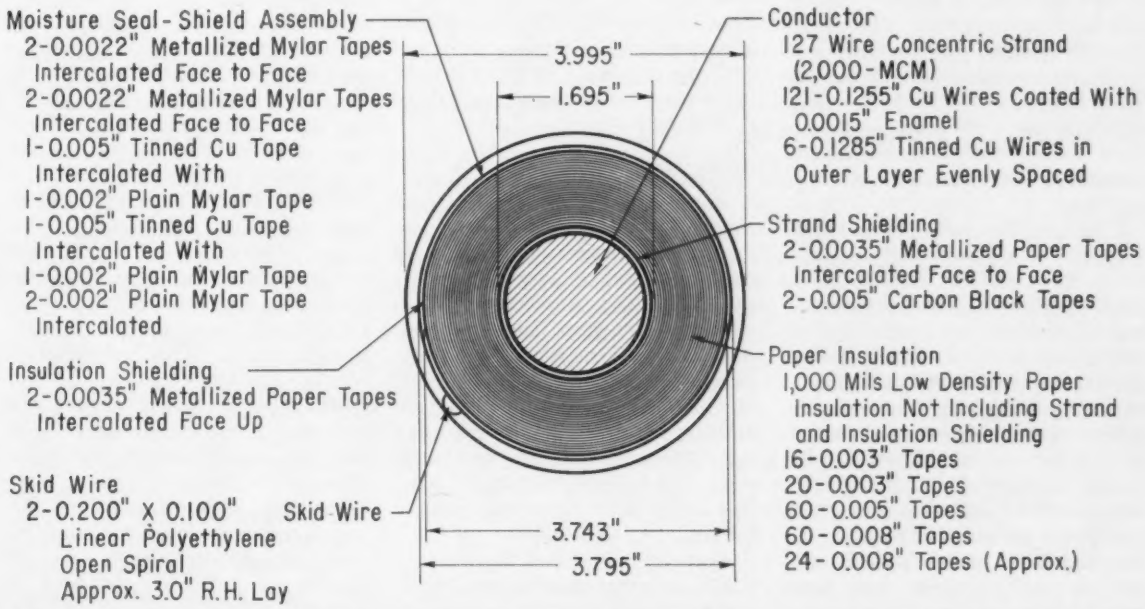
To meet the first objective the high-pressure oil-filled pipe type system was chosen because experience has shown it to have a high degree of mechanical ruggedness for the heavy-duty load requirements met under power system conditions in the US.

To provide a cable that is itself rugged, a new 345-kv production line, air conditioned to 10% relative humidity, was installed. This made possible a cable structure which not only has a high degree of compactness and uniformity in the dry unbent state, but one in which this condition is maintained with little or no change in all subsequent drying and impregnation operations.

To meet the second objective, a special paper with low inherent power factor and density has been developed.

To meet the third and last objective the system and the cable have been so designed that direct contact between oil and copper has been kept to a minimum.

The cable is a single-conductor, 2,000-MCM, having copper con-


Moisture Seal-Shield Assembly
2-0.0022" Metallized Mylar Tapes Intercalated Face to Face
2-0.0022" Metallized Mylar Tapes Intercalated Face to Face
1-0.005" Tinned Cu Tape Intercalated With
1-0.002" Plain Mylar Tape
1-0.005" Tinned Cu Tape Intercalated With
1-0.002" Plain Mylar Tape
2-0.002" Plain Mylar Tape Intercalated
Insulation Shielding
2-0.0035" Metallized Paper Tapes Intercalated Face Up
Skid Wire
2-0.200" X 0.100" Linear Polyethylene Open Spiral Approx. 3.0" R.H. Lay
Skid Wire
3.995"
1.695"
3.743"
3.795"
Conductor
127 Wire Concentric Strand (2,000-MCM)
121-0.1255" Cu Wires Coated With 0.0015" Enamel
6-0.1285" Tinned Cu Wires in Outer Layer Evenly Spaced
Strand Shielding
2-0.0035" Metallized Paper Tapes Intercalated Face to Face
2-0.005" Carbon Black Tapes
Paper Insulation
1,000 Mils Low Density Paper Insulation Not Including Strand and Insulation Shielding
16-0.003" Tapes
20-0.003" Tapes
60-0.005" Tapes
60-0.008" Tapes
24-0.008" Tapes (Approx.)

CABLE NO. 2—General Cable's high-pressure, oil-filled, pipe-type cable consists of 2,000 MCM single conductor with enameled copper strands. Special paper was developed as prelude to manufacture of test cable

centric enameled strands. It has strand shielding, 1-in. of oil-impregnated paper insulation, insulation shielding, a moisture seal and shielding assembly, and polythylene skid-wire overall. Two such single-conductor cables, making up a single-phase loop, were installed in a 10.75-in.-OD steel line pipe. The latter was filled with oil, maintained under a nominal 200-psig pressure by means of a pumping plant installed nearby.

Install New Production Line

The field test cable was manufactured on a newly installed production line capable of insulating commercial lengths of 345-kv cable in a single pass through the machine. This production line has new taping heads with pre-calibrated springs for tape-tension control, compensating means for maintaining tape tension constant independent of pad dimensions, an automatic device for bringing the machine to a stop before a tape runs out, and means for accelerating the machine at a predetermined rate from standstill to its prescribed running speed.

This production line is housed in an enclosure with air conditioning equipment capable of maintaining a constant relative humidity as low as 10%. Moisture content of the insulating paper is brought into equilibrium with the relative humidity selected for manufacture by passing the paper in wide sheets through heated rolls and then into a slitting room held at selected relative humidity. There the "jumbo" rolls are slit into pads which are then transported on an air-conditioned conveyor system to each taping head.

The line has also a "traversing takeup," a take-up reel mounted in a floor pit and free to move horizontally and vertically, its movements synchronized with that of the taping machine. The point on the take-up reel which the cable is to occupy is kept by this movement always directly in line with the axis of the caterpillar capstan and the taping heads. This arrangement eliminates the indeterminate bends and twists to which a cable in the dry and least flexible state is subject in moving back and forth across a conventional fixed take-up reel.

The field-trial cable length contains a specially developed low-density, wood-pulp paper 3 to 8 mils thick.

Studies showed that metals, particularly bare copper, in contact with mineral oil at high-voltage temperatures and electrical stresses, have a catalytic effect that develops deleterious products in an oil-filled cable. Accordingly, to minimize direct contact between bare copper and oil, most of the individual wires of the concentrically stranded 2,000-MCM conductor were coated with a thin layer of synthetic enamel. The enamel can be flushed away with hot solder for the application of a compression-type connector to the conductor.

Theory and measurement agree that enamelling the strands gets rid of the proximity effect both "in air" and "in pipe." The overall 3-phase "in pipe" ac-dc ratio for a 2,000-MCM concentric conductor with enamelled strands has been found to be comparable with that of a 2,000-MCM compact segmental conductor. Bare copper-oil contact was minimized in the system as a whole through the use of tinned copper, aluminum, stainless steel, or non-metallic materials for shielding tape, skid wire, riser pipe, etc.

Prototype lengths of cable alone and in combination with a normal joint were load-cycled at 60 cps and 100 psig without failure up to 300 kv-to-ground (520 kv, 3-phase) with conductor temperatures up to 100C. Power factor tests before and after load cycling showed values at 100 psig ranging from about 0.18% at room temperature to about 0.20% at 90C.

Surge Tests Made

Room-temperature and "hot" (about 75C) surge tests were made on samples before and after load cycling at crest voltages up to 1,300 kv. These tests were made with a 1.5 x 40 μsec wave shape and both positive and negative polarities. Tests comparable to the AEIC High-Voltage Time Test were made at 100 psig on other samples, using such schedules as 350 kv conductor to ground for 6 hr, 442 kv for 3 hr, 534 kv for 3 hr, all without sample failure.

Complete details of the General Cable and other installations at Cornell are given in AIEE Publication T-129, Extra-High-Voltage Cable Conference, March 1961.

High-Pressure

E. J. MERRELL, Chief Engineer,
A. L. McKEAN, Electrical Research Director, Phelps Dodge Copper Products Corp, Yonkers, N. Y.

A self-contained, high-pressure (200-psig), oil-filled cable system was furnished to the Cornell test by Phelps Dodge. This aluminum-sheath cable embodies features of the pipe-type and low-pressure, oil-filled designs and is suitable for both direct burial and duct installation.

This cable has an annealed prespiralled segmental conductor and has graded paper thickness externally as well as in the strand region. Paper thickness starts at 1 mil at the conductor and graduates to 6 mils in the wall, slimming again to 2 mils at the overall insulating shield. The paper was made with deionized water.

Impregnant Can Be Frozen

The cables low-viscosity impregnant can be frozen with dry ice. The sheath is of large-diameter, extruded aluminum, and the corrosion-protective jacket is extruded, high-density, high-molecular-weight polyethylene. The joint sleeve was assembled mechanically. The cable system incorporates a combined oil-treating and pumping plant and has argon atmosphere in the oil storage tank.

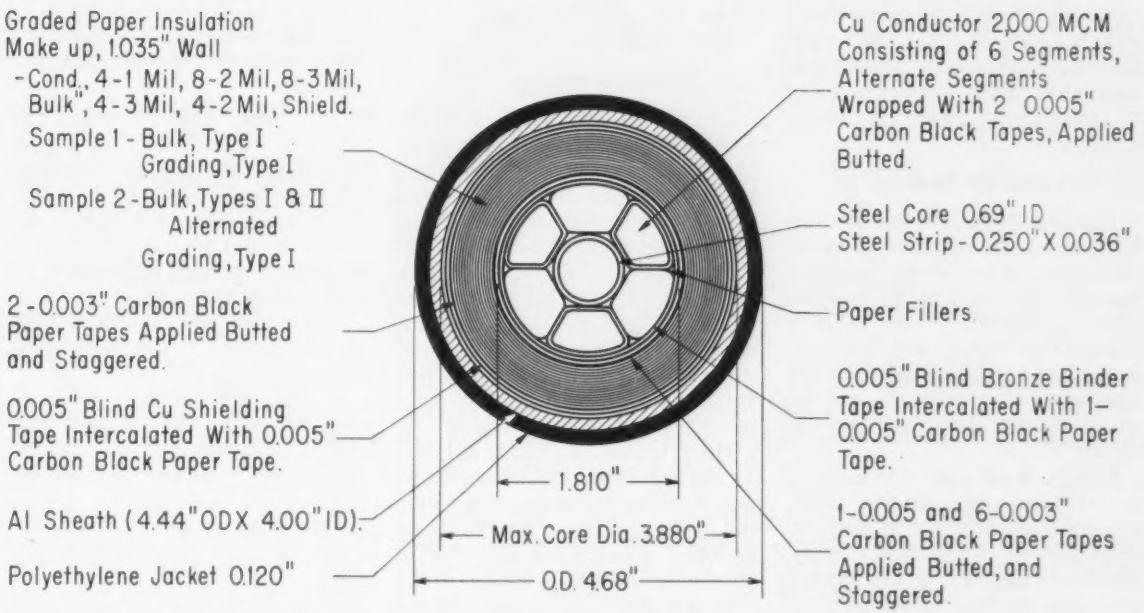
A mathematical survey of applicable cable designs' capabilities led to the single-conductor, self-contained approach as that affording the inherent advantage of high ampacity. Experience with aluminum sheath production suggested a self-contained, high-pressure, aluminum-sheathed cable system. The cooperative nature of the Cornell project allowed the company to presume that desirable alternative designs would be sponsored by other manufacturers. This presumption was justified by events.

Two 1,000-ft lengths of the cable were manufactured for the project. One was insulated with the paper made with deionized water; the other with a combination of this paper and the company's usual intermediate-density paper. Sample lengths of each are on test at Cornell.

Installation proceded essentially in accordance with low-pressure,

EHV Cable Systems *(Continued)*

Aluminum Sheath Is Cable System Feature



CABLE NO. 3—Phelps Dodge's sample has annealed prespiralled segmental conductor, special paper, and a low-viscosity impregnant for dry-ice freezing during splicing to restrict oil flow in hilly terrain

oil-filled cable practice, except that dry-ice freezing was used in splicing to restrict oil flow. The freezing procedure sought to simulate future use of the splicing technique in hilly terrain. To establish a background of cold-weather experience, installation was begun in February and completed in March 1960. Snow fell 80% of the working days, and the temperature hovered near zero much of the time.

Capability and Stability Sought

Cable design objectives were maximum-load capability and dielectric stability, and the limiting factors were a cable diameter not too large for shipment and the maximum permissible operating temperature. Paper cable research indicated that 120C was a feasible temperature for emergency overload considerations and this temperature became a controlling base point.

A 4-in. core diameter was suggested as practical by the company's experience in shipping large-size coaxial cable by railroad. This diameter became another control. A nominal insulation thickness of 1 in. was adopted as adequate for the 345-kv rating. This fixed the maximum conductor size at 2,000 to 2,500 MCM, allowing a ¾-in. hollow-core for oil-demand compensation.

Plain Copper Strand Used

Plain copper strand was selected for the conductor, such strand, as analyses showed, having no significant deleterious effect on dielectric strength in a closed oxygen-free cable system. Individual segments were prespiralled to facilitate assembly of the conductor into a compact, segmental unit. The six-segment design assured minimum electrical losses and mechanical flexibility, and annealing augmented these desirable properties. Individual prespiralled segments were annealed with a continuous induction annealing line.

Ac-dc ratio measurements on a 50-ft run of 2,000-MCM, six-segment conductors, with 9-in. cable spacing, center-to-center, gave values of 1.041 at room temperature and 1.032 at 90C.

Advantage was taken of the enchanced dielectric strength of thin paper designs by grading down the thickness of the insulating tapes to 2 mils at the insulation shield and 1 mil in the strand region. In the company's evaluation program, more than 300 different papers, ranging in apparent density from 0.70 to 1.20, were considered. The fundamental requirement of low power factor clearly had to be achieved with minimum paper density. Thus, the physical properties of paper, such as rigidity, finish, friction, tensile strength and elongation under appropriate humidities, were evaluated thoroughly.

Proof Test Samples

Prototype samples of 2,000-MCM conductor cable with 1-in. of insulation wall were manufactured for full-scale proof testing, employing selected insulating papers for optimum performance based on earlier work.

The cable's impregnant had to have minimum dielectric loss and, for hydraulic reasons, as low a viscosity as was consistent with electrical stability. A further requirement was a "hard-freeze" temperature that would permit dry-ice freezing during installation,

changeover, or repair. A water-white paraffinic oil was selected. This oil has Saybolt second viscosities at 100 and 210F of 89 and 38, respectively. Its hard-freeze point is —45. Its high refinement minimizes its susceptability to contamination, aiding its retention of its initial low percentage power factor.

Has Extruded Al Sheath

The aluminum tube for the two 1,000-ft lengths of cable prepared for Cornell, as well as for the prototypes, was extruded by the multiple-billet technique. After pressure testing, this tubing was delivered at the cable plant where the dry cable cores were drawn in, and the tubing swaged down to form the sheath.

The corrosion-protective jacket is an extruded, high-density, high-molecular-weight grade of sunlight-protected, black-pigmented polyethylene. This material was selected as a high-strength complement to the seamless extruded aluminum sheath, suitable for either direct burial or for installation in an underground duct system.

The prototype cable samples were subjected to design tests in accordance with specification set up by the Steering Committee. These included 1,175-kv impulse withstand between 75 and 90C. Shorter tests, supplementing the committee program, were carried out essentially in accordance with AEIC cable specifications and AIEE Standard 48 on potheads. The cable prototypes met all test requirements, power factor and capacitance remaining unchanged. A cable with a test splice withstood extended testing at the 6-hr voltage of 373 kv to ground.

Test Performance Summarized

The cable design test performance is summarized as follows:

1. The 6-hr test was completed at 373 kv to ground.

2. Impulse voltage to 1,435 kv negative polarity, 1,420 kv positive polarity, including 39 pulses at 1,300-kv level, were sustained, only 1,175 kv being required. Test temperature of the cable was 95C maximum.

3. The cable also withstood 680 kv to ground, 60 cps, for 1 min.

4. Extended 6-hr testing at 373 kv to ground, including splice, comprised 369 hr at room temperature and 175 hr at 85C.

5. Test assemblies showed complete stability throughout all tests. Power factor and capacitance remained unchanged.

Load Tests Speed Evaluation

Long-time, load-cycle tests at high voltage speeded evaluation of operational stability of prototypes. Heating by load current combined with dielectric loss induced by the test voltage up to about 110C conductor temperature took place over five days. The heating current was raised in daily steps so that measurements could be taken at different temperatures. Normal cooling during the sixth and seventh days completed the weekly cycle.

High voltage was superimposed on this test cable nightly for 16 hr and continuously during the weekend cooling. Voltage was increased in equal steps from 200 kv to ground in the first week to 29 kv (500 kv phase to phase) in the fourth week and maintained at this level for the rest of the ten-week program. The resultant dielectric loss created an additional rise in the order of 10C in conductor temperature.

The test arrangement consisted of a U-shaped cable prototype with a bend radius of 8 ft and 55 ft long, and it terminated in G&W potheads.

Prototypes Show Stability

All four prototype constructions, subjected to from one to three ten-week test periods, exhibited stability. Before load cycling, one specimen had been subjected to the 6-hr and 1-min 60-cps tests as well as impulse testing to over 1,400 kv to ground.

Much study was given to potheads, joints, and oil supply. The account of the development of potheads appears elsewhere. The dielectric and metal parts of the joint were developed by extrapolation of past experience at voltages up to 230 kv. The feasibility of retaining design features proved by field practice, such as the four-ram compression connector and crepe paper splicing tape, was demonstrated. A double-function pumping plant was designed to handle the oil supply, treat impregnant in the field and to provide hydraulic compensation for the cable system.

Low-Pressure,

E. C. EICH, Assistant Chief Engineer,
L. C. EBEL, Senior Engineer, Anaconda Wire & Cable Co, Hastings-on-Hudson, N. Y.

■ The cable system installed by Anaconda Wire & Cable Co at Cornell is a low-pressure, oil-filled, self-contained design, along rather conventional lines, yet introducing several variables for the purpose of obtaining important information on EHV cables and accessories.

The system consists of the following components, enumerated from one end of the circuit:

1. A capacitor-graded terminal, rated for up to high pressure (200 psig nominally), manufactured by Ohio Brass Co. For the test the terminal was modified for use on self-contained cable, and will be operated at low pressure (15 psig nominally).

2. A 225-ft length of main cable under test.

3. A stop joint, which, for convenience, is hydraulically bypassed, is under electrical test but does not perform its hydraulic function.

4. A 200-ft length of cable of the same construction as the main cable installed in a loop, returning to the same manhole.

5. A straight-through (no hydraulic isolation) joint.

6. Another length of main cable.

7. A non-graded terminal for operation at low pressure

8. A gravity feed oil reservoir supply system.

The joints and low-pressure terminal were designed and manufactured by Pirelli, Milan, Italy. Modifications for the special test requirements were made, principally, power factor gaps. Each component of the system, including the internal components of the terminals, is electrically isolable for measurement of power factor.

Study Insulating Materials

In anticipation of the Cornell tests, much research work was done on insulating materials, natural and synthetic.

The culmination of this research was the production of a four complete 1,200-ft prototype cables submitted for short-time "acceptance" and long-time cyclic loading tests. Of these four cables, all were of a

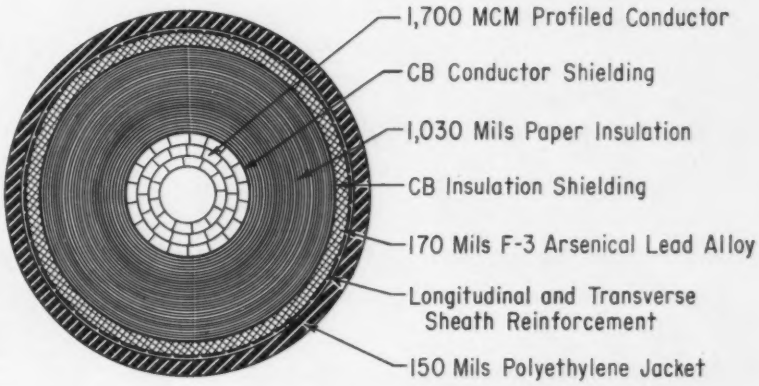
Oil-Filled Cable Has Self-Contained Design

low-pressure, oil-filled type. Thus direct comparisons of insulation systems is possible. Three cables were insulated with special paper, impregnated with three different oils; the fourth was insulated with specially prepared polycarbonate film tapes impregnated with an ultra-thin synthetic oil. The cyclic loading tests, energized in 1958, were completed in 1961.

For the tests the cables continuously carry voltage, current loading being adjusted to yield a desired conductor temperature. Test conditions were maintained, i.e., the voltage level and conductor temperature, until the testers have reason to believe that stability is reached.

We strongly believe that periodically power factor, stress and temperature spectra must be taken, so as to follow closely the relative performance of insulating systems. Preferably, such spectra should be taken at the time of any contemplated change in test conditions.

Power factor vs stress data was taken initially and after prolonged aging of one cable, and was evaluated in the program. This cable is the prototype of the one installed at Cornell. Power factor may be taken at 0.20%.


1,700 MCM Profiled Conductor
CB Conductor Shielding
1,030 Mils Paper Insulation
CB Insulation Shielding
170 Mils F-3 Arsenical Lead Alloy
Longitudinal and Transverse Sheath Reinforcement
150 Mils Polyethylene Jacket

CABLE NO. 4—Anaconda's sample is a low-pressure, oil-filled, self-contained design. Polycarbonate film tapes, impregnated with thin oil, are insulation

All Synthetic Cable Tested

An all-synthetic cable insulated with polycarbonate film impregnated with ultra-thin oil was also tested in the laboratory. Two especially important facts are evident. First, the typical value of power factor is about 0.05%, approximately 75% below that of an excellent paper cable. (EW April 17, p 60)

Secondly, there are significant differences in both level and shape of the curves, both power factor vs temperature and vs stress, from the initial condition to the aged condition. Since it is difficult to explain this change as an "improvement," it is felt that it is important to recognize that traditional criteria of cable insulation deterioration are frequently inapplicable to synthetic systems.

As a result of data collected in the cable development program, it was concluded that:

1. Paper made entirely with entirely deionized water gives significantly reduced losses at high temperature (100C) and gives long-time stability.

2. Carbon-black, semi-conducting shielding over the conductor and insulation is advantageous in EHV cable.

3. Synthetic oils can be compounded with improved chemical and electrical performance, although at greater cost.

4. An all-synthetic cable is now possible at the highest voltages with greatly reduced losses, significantly reduced insulation thickness for a given voltage, and long-time stability under high-voltage, high-temperature conditions.

5. Laboratory cyclic aging testing, because of superior control of testing conditions, yields more development information than field testing. But it must include power factor-stress-temperature spectra to follow deterioration adequately. Simple lack of failure doesn't give much information. Such results must be interpreted with great care. Laboratory cycling must be conducted with an absolute minimum of artificialities, and if any are present they must be evaluated with great care.

Condenser Pothead Uses Doughnut Design

J. H. NICHOLAS, Chief Engineer, G&W Electric Specialty Co, Blue Island, Ill.

■ Extra-high voltage, high pressure, large conductor size, and economics influenced the use of condenser voltage grading in the potheads designed for the Cornell tests by this company.

The specifications for the Cornell application, along with economic considerations, showed certain advantages for the condenser control of voltage gradients at 345 kv. This represented a departure from conclusions based on its long experience in manufacturing cable terminations for voltages up to and including 230 kv. That experience had convinced G&W of the advantages of the conventional stress control type potheads, containing a minimum of electrodes for influencing division of voltage and controlling areas of maximum gradients.

The 1,300-kv BIL established for the 345-kv pot-

(Continued on page 52)

- Strings conductors and winch lines
- Transports and sets wood poles
- Moves construction crews
- Transports and sets assembled towers

PRE-PACKAGED STEEL BUNDLES are hauled from marshalling yard to tower location by helicopter in easy operation

Helicopter Reduces Transmission

R. E. BAIR, Transmission Construction Engineer,

E. S. ZOBEL, Transmission Engineer, American Electric Power Service Corp

Helicopters can cut over-all construction time of transmission lines by one-half and may reduce transmission line costs. A test of the helicopter's capabilities and an economic evaluation of its use in transmission line construction was started on August 15, 1960, by the Appalachian Power Co, a subsidiary of the American Electric Power System. About 17 miles of single-circuit wood pole H-frame structure and 13 miles of double-circuit steel tower line were built by helicopter methods near Lynchburg, Va. These 69 and 138-kv lines provided a comprehensive test of the helicopter's capabilities.

In 4¼ hr flight time, the helicopter delivered 268,000 lb of steel in 82 bundles averaging 3,268 lb to 4½ miles of right-of-way. About 900,000 lb of tower steel and hardware were hauled in 20½ hr. The helicopter was used to string out conductors and winch lines, and to transport and set wood poles, steel tower panels, assembled H-frame wood structures, and an assembled aluminum guyed V-tower.

These tests were made to determine economics of helicopter construction, and it was necessary to learn:

1. The helicopter's capability and economic flying distance.

2. The economics of the helicopter as an integrated construction tool.

3. Changes in the traditional or conventional construction methods.

4. Pre-planning requirements.

The speed and cost of the helicopter require that the construction program be planned around its capabilities. The chart illustrates Appalachian's experience with the helicopter, and will aid the planning, scheduling, and estimating of future jobs.

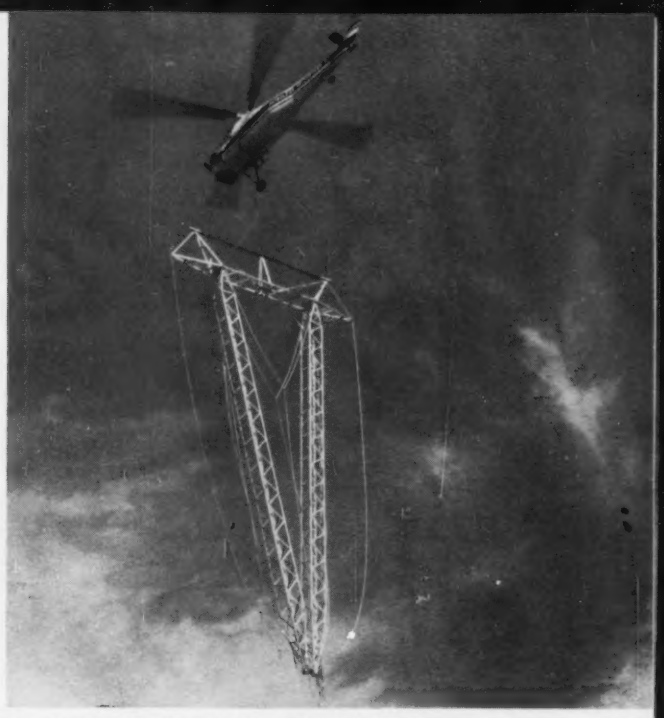
Schedules must be set and maintained closely. All materials should be on hand, packaged or framed, prior to arrival of the helicopter. Material should be bundled properly as to weight and tower location. For safety, men should be equipped with goggles and helmets because of the downwash of air under the rotor blades. The proper number and arrangement of manpower is important for the most efficient utilization of the helicopter.

Contractors should be encouraged to use the helicopter as part of their construction equipment. This however presents many problems because of the high cost of helicopters. If the contractor does not supply the helicopter, his contract should provide incentives for him to use the helicopter efficiently. This is very important because the most efficient use of the helicopter requires proper arrangement of manpower and other equipment on the ground.

Helicopter Is Contracted

Helicopter can be furnished on: **(1)** a guaranteed number of flight hours at a straight hourly rate; **(2)** a monthly rate plus a flight hour rate; **(3)** a daily rate plus a flight hour rate; or **(4)** a long term lease arrangement. In this case, Appalachian Power contracted with Petroleum Helicopters to furnish helicopter and crew. Collier Construction Co and Hoosier Engineering Co, contractors, furnished labor and other equipment on a cost plus basis.

HELICOPTER PULLS CONDUCTOR under slight tension; will lay conductor into stringing blocks at end of insulator string



ASSEMBLED ALUMINUM V-TOWER is hauled from marshalling yard to tower site over woods and creeks by helicopter

Construction Time 50%

Tower steel was delivered to the three marshalling areas by truck. Shipped knocked down and by piece mark, each bundle generally contained like pieces. The bundles were then broken open and rebundled for each tower, an expensive operation because of late deliveries of steel. Calculated weights of each piece less 2% for fabrication were used to determine the bundle weights. About 75% of the bundles weighed 3,500 lb and 25% weighed 3,750 lb. Bundles of 1,500 lb made up of tower rather than piece-mark steel would be an alternative method of buying steel.

Locations were set aside in the marshalling area for each tower, and a number visible from the air was placed beside each location; corresponding numbers were placed along the center line at every other tower location.

Two 18-ft steel cables, having eyes in each end, were looped around the ends of each bundle. A shackle tied the two cables together and slipped over the cargo hook suspended from the helicopter.

The pick-up, flying, and placing of the bundles required only one man on the ground for making the hook-up. This man's speed controls the entire operation substantially.

Steel tower panels, or first sections, were assembled with one complete face and lacing for another face. The helicopter raised the panels and held them suspended, while the erection crew bolted the tower legs to the stub legs. The helicopter released each panel as soon as the tower legs were bolted. Tag lines held them in position while the lacing for the two remaining sides were brought into place and bolted.

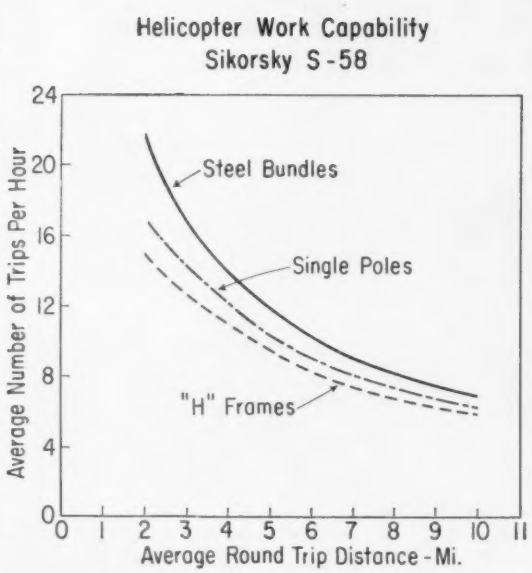
A template was made to position the tower legs properly to the stub legs for easier bolting. This template, attached to the stub legs by C clamps, allowed the tower legs to telescope over the stub legs, provided a stop position, lined up the bolt holes, and permitted easy bolting of the sections. Flight times for this operation varied from one min 12 sec per panel to six min 28 sec.

Erecting panels was not a continuous operation, and a considerable amount of jumping from location to location was necessary. If panel erection were planned on a production basis, the 3.15¢ per lb cost could be reduced substantially. Proper balance of manpower and flight time is again important for lowest costs.

Poles Were Hauled

Numbers visible from the air were placed at the structure locations along the line, similar to the hauling of steel structures. Poles or structures were laid out in the marshalling area and identified by structure number. A cardboard tag was stapled to the top of the pole marked L for left, R for right, and M for middle pole. The man flying in the bay door directed the setting of poles in their proper location. In setting the poles, two men were used for single poles and four men for H-frame structures.

Poles were hauled and set in prepared holes, both as single units and as complete two-pole H-frame assembled structures. Western red cedar poles were used because of their lighter weight. Poles up to 80 ft weighing 3,360 lb were hauled. Sixteen structures of Class 3 and 4 poles, 50 and 55 ft long, were transported and set in holes complete with crossarms, "X" braces, insulators, and hardware. All others (131) were hauled as



HELICOPTER DELIVERS 12 steel bundles or ten single poles each hour when average round-trip distance is five miles

SPECIAL PIN TRIPPING DEVICE enables man on ground to release pole, enabling helicopter to haul multiple loads

single units with crossarms securely banded to the poles.

A special pin tripping device was developed for the pole hauling operation. It allowed the man on the ground to release the pole as soon as it was in the hole. The device saved cable slings and allowed the helicopter to haul multiple loads and release partial loads at different locations. Due to the twisting and fouling of lines during flight, it did not prove too successful. However, the method can be improved and be made satisfactory for future construction.

Hauls Aluminum Structure

Plans to use an 86-ft aluminum structure weighing 2,900 lb including guys were developed for 138-kv single-circuit lines. The V-structure has been installed in one of ALCAN's 345-kv lines and has performed satisfactorily for two years.

Guy anchors for this installation were circular precast concrete slabs weighing about 1,000 lb with a clevis in the center. They were connected to the guy by a long eye rod and preformed guy grips. The center foundation was reinforced concrete poured in place. On future construction, precast slabs will be used for this foundation.

The completely assembled aluminum structure was picked-up and hauled from the marshalling yard by helicopter, 9/10 mile, and set on a prepared foundation in six min. The structure was returned to the marshalling yard, and the setting repeated three times before leaving it in its final position. The experience gained in these four flights will help plan future projects.

Different methods were tried to catch and hold the structure while the helicopter hovered. The first setting was made by grabbing each of the four guys to the anchor rods with chain hoists and Klien type wire grips. The remaining three settings were made by catching temporary rope guys from four directions of the line. Permanent guys may be use in the future.

The structure moved through the air very easily. Variable wind conditions made little difference. Being a lattice structure, it trailed up and down but did not cause any difficulty for the pilot. In one instance the structure was flown at a ground speed of 45 knots into a 40 knot headwind. Except for the slow flying time, the setting was normal.

Helicopter Strings Conductor

This type of aluminum structure offers the greatest savings in construction by helicopter. Travel time for assembly crews is reduced, and setting crews can be moved by helicopter. More powerful helicopters such as the Sikorsky S-61 will haul 7,500 lb payloads, about twice the capacity of the S-58.

Conductor, ground wire, and lead or winch line were pulled out by helicopter. Various methods were tried, the most successful and economic being the pulling of lead lines on the double-circuit steel section of the line. In all methods of pulling, the conductor or lead line was attached to a 1,200-lb weight. The weight was suspended by steel cable about 25 ft below the helicopter cargo hook. A one-in. rope 150 ft long was used ahead of the conductor or lead line being pulled.

During all stringing operations the pilot flies from the right hand seat and is guided by an observer, riding in the bay door, located also on the right hand side of the helicopter. The observer directs the pilot over an intercom system. Since the rotor of the helicopter is 56 ft in diameter, and space is often at a premium, his role is very important. For this reason, it is important to set up the conductor reels or winching machines so that the structures would be on the right hand side of the helicopter during the pulling operation.

First attempts were to pull 556,600 CM ACSR 26/7 conductors of 10,000 ft length. The first six conductors were pulled 9,600 ft with very little difficulty, but with some indication that the limit of the

(*Continued on page* 42)

"FOLLOW-ACTION" CONTACTS

OF KEARNEY "GX" CUTOUTS

...eliminate danger of external arcing
...prevent recoil damage

KEARNEY

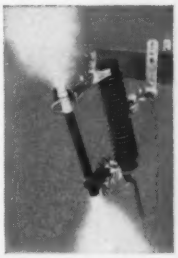
"FOLLOW-ACTION"

LOCKS CONTACTS CLOSED UNTIL FAULT IS INTERRUPTED

Stainless steel springs in the top contact assembly of the Kearney GX cutout, absorb shock... and by "following" any motion of the cartridge created by recoil impact, keep the top contacts firmly locked together under high pressure until the fault has been interrupted. Contacts cannot separate during interruption to cause external arcing or contact burning.

Ball and socket contacts are self-aligning, cannot be bent or twisted out of alignment by severe faults, and always seat properly regardless of the angle of cartridge close-in. Dependable, safe operation is assured.

Balanced Double Venting . . . prevents recoil damage. Expendable cap blows on high faults. Expulsion gases discharge from both ends of the GX cartridge to equalize pressure and neutralize recoil shock. At the same time, relief of excess pressure within the cartridge prevents tube bursting. On low amp faults, the GX cartridge single-vents from the bottom only, assuring ample gas pressure for positive interruption.



Cast Bronze Hood . . . prolongs cutout and contact life by protecting top "follow-action" contacts from severe weather and ice. Hood also shields contacts from dirt and corrosive elements, providing added insurance of dependability and long life. Extra-wide entry jaws guide cartridge securely into contacts even at awkward close-in angles.

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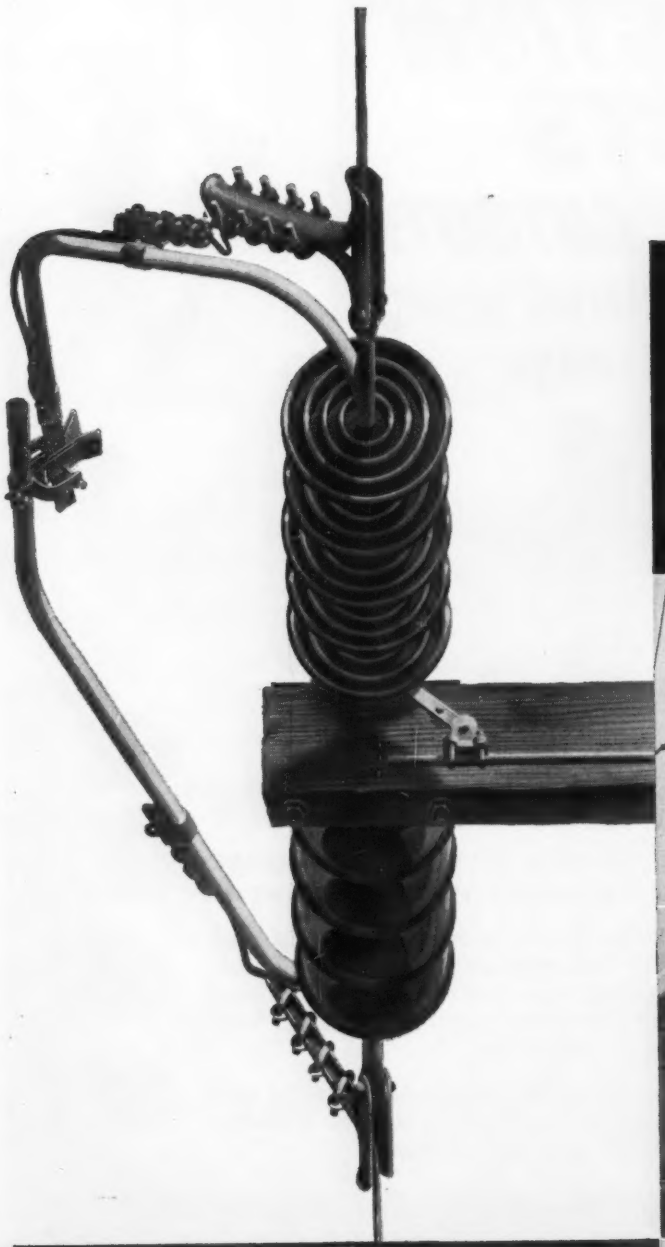
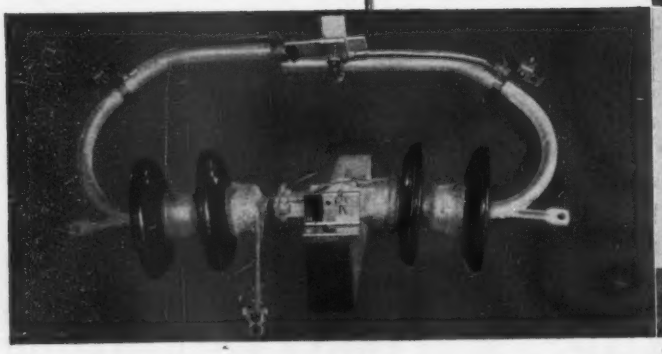


design



simplicity

KPF switches are simple and functional in design. This insures a clean, attractive pole top whether phase units are installed in a triangular, vertical or horizontal configuration.

The simple design of KPF switches also assures operating dependability under all weather conditions. KPF switches have no delicate mechanisms to malfunction, freeze, lock, need lubrication or wear out.

KPF switches have proved themselves in almost 50 years of service on major utilities. Make a test installation. Discover their unique dependability on your own system.

Install in the air—or on the ground

- Top (left)—phase units installed in the air, on previously mounted cross arm.
- Middle—phase units installed on cross arm while on the ground.
- Bottom—phase units and cross arm installed on the ground—pole then tilted into place.

Write direct for catalog

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P.O. Box 1257E
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KPF
AIR BREAK SWITCHES
Standard for nearly half a century

Helicopter Reduces Line Construction Time (*Continued from page* 38)

helicopter's capabilities were being reached. Two other attempts failed to reach the objective, and it was decided to use one-half in. lead line on the section having 556,500 conductors.

For road and line crossings, the pendulum swing of the lines as they were pulled requires that the width of guard structures be increased to at least 25 ft from the outside phase position.

Chafing and cutting of the conductors may occur as they are dragged over each other. This problem would be inherent in any structure of vertical configuration. Due to the transverse swing it would be impossible to keep conductors spaced properly on the ground or in guard structures.

Therefore in pulling with lead lines, enough brake was applied to the shipping reel to keep the conductor in line and, in most cases, free of the ground. This stringing under semi-tension gets the conductor in the air with very few abrasions.

Trees in the right-of-way in two valleys were not cut. Clearing of the right-of-way stopped where the conductors in their final sag position would clear the ground by 100 ft. Lead lines were pulled across these two sections and allowed to lay in the trees. No trouble was experienced when the lines were lifted out of the trees as they were brought up to tension.

For pulling lead lines, two winching machines each with 12,000 ft of line were used. The two machines were set, one at each end of the pull along with three reels of conductor. The helicopter pulled the line off the winches and layed it into stringing blocks attached to the ends of the insulator strings. This was done in an around-the-clock operation. The helicopter pulled the line down one side of the towers and back the opposite side. While the lead line was being pulled back, conductor was being pulled by winch on the opposite side. The pulling of the winch lines, about 20,000 ft of line, took an average of 36 min flying time. Best output was 121,000 ft of conductor ready for sagging in four hr and 30 min of flight.

Special stringing blocks, open on one side with an outrigger arm extending out at 90 deg to the line and with a vertical angle of 45 deg, were tried. This allowed the helicopter to lay the rope section of the lead line in the blocks without the help of a man on the tower. Some difficulty was experienced in keeping the blocks from twisting during the time the helicopter was getting rope in the block. This twisting problem may be solved by improving the method of hanging the blocks and shortening the outrigger arm.

Side opening latch type blocks were also used. The helicopter flew the lead line in close enough for a lineman to place it in the block and close the latch. This latch type block did not slow down the pulling operation to any appreciable extent but required a man on each tower.

The 219,900 CM ACSR conductor on the 66-kv H-frame line was pulled in lengths up to 8,800 ft. Stringing conductors for horizontal configurations requires that the middle conductor be passed under the crossarm, which means it must be disconnected from the helicopter, passed through the H-frame, and reconnected to continue pulling. This was done by a rope threaded through the block. The two ends were layed far enough away from the structure to allow the helicopter to lower the weight to the ground, close to the two ends of the threaded rope. The conductor was then disconnected from the weight and attached to the back end of the threaded rope. The head end of the rope was then attached to the weight. The threaded rope then became a part of the pulling line. Two men required an average of 35 sec to make this transfer.

A special cradle to carry reels of conductor and ground wire underneath the helicopter was built. The frame work of the cradle was made of magnesium sections to reduce the total weight to about 250 lb. A hydraulic, drum-type brake was built into the cradle and operated by the man in the bay door. The brake was used to control the spinning of the reel and laying of the conductor. The cradle operation was not too successful due mostly to inadequate braking.

Flight Times & Cost for Construction Operations

Description	Flight Hours	Flight Cost	Unit Cost	Quantities
Hauling steel	20:30	$7,175.00	$0.00803 per lb	893,175 lb
Hauling poles	17:37	6,165.83	$37.83 per pole $79.28 per structure	165 poles
Stringing Conductor	39:41	13,889.16	$136.70 per cond. mile	101.6 cond. miles
Erecting Steel Panels	5:00	1,750.00	$0.0315 per lb	55,560 lb
Hauling & Setting Aluminum Tower	:32	186.67	$46.67 per structure	4 structures
Other Experimental	2:15	787.50		
	85:35	$29,954.16		

SPECIAL STRING BLOCKS allow helicopter to lay lead line in stringing blocks without man on tower

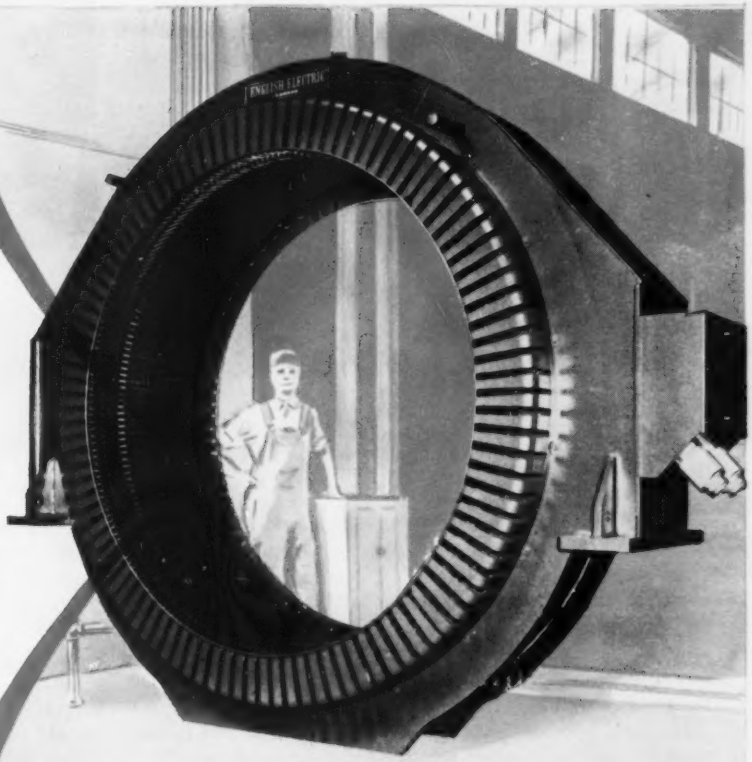
ENGLISH ELECTRIC CANADA

USES

NATVAR

Teraglas®

TO TAPE STATOR COILS OF THIS 4500 HP MOTOR



This unit, one of four built by English Electric for export to Europe, is a 4500 HP, 6000 V, 3-phase, 50 cy. synchronous motor stator. Coil ends are taped with Natvar Teraglas, a new flexible insulating material comprising a base fabric woven from polyester (polyethylene terephthalate or "Dacron") warp yarns, and continuous filament glass filler yarns, coated with an improved varnish possessing exceptional dielectric strength under elongation.

English Electric Canada, Toronto, Ontario, Division of John Inglis Co. Ltd. manufacture electrical motors, controls, transformers and switchgear for use in important installations throughout the world.

They have found that Teraglas offers several distinct advantages over the thirsty cotton base tapes formerly used. At no advance in material cost, Teraglas is more readily applied to coils; the higher dielectric strength of Teraglas results in a better insulated coil; and better heat resistance provides a greater safety factor against high operating temperatures due to overloading.

If you are presently using conventional materials, it will pay you to consider the ease of use and extra protection of Teraglas. It is made in four standard thicknesses, .008", .010", .012" and .015", available in sheets, rolls or tapes in black and yellow.

Teraglas® U.S. Pat. Off. (Natvar Corp.)

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- Vinyl coated and silicone rubber coated Fiberglas tubing and sleeving
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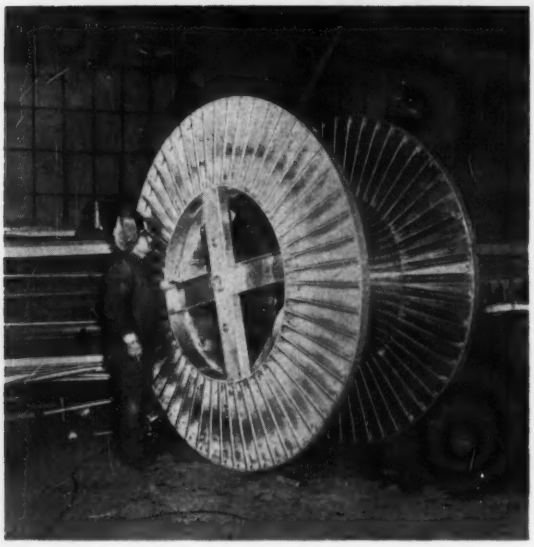
- Styroflex® flexible polystyrene tape
- Extruded identification markers

*TM (Reg. U.S. Pat. Off.) OCF Corp.

We will be very happy to supply information on any of our products on request.



Aluminum Cable Reels Cut Handling Costs

The Northern Electric Co and the Quebec-Hydro Corp are cutting shipping charges—on full cable reels received and empty reels returned—by using aluminum cable reels rather than the conventional steel or wooden reels. Furthermore, the aluminum reels provide greater cable capacity for a given full-reel weight, make for easier handling in the field, do not require painting and from experience require a minimum of maintenance.

Through the coordinated efforts of the Aluminum Co of Canada Ltd, Argon Electric Welding Co, Quebec-Hydro Corp and Northern Electric Co, welded aluminum reels, 104-in. in diameter, by 56-in. and 40-in. traverse, are now available. These reels weigh 835 lb empty as compared to 2,370 lb for an 84-in.-dia wooden reel—yet they hold 10,000 ft of 1.38-in. cable compared to 7,000 ft carried on the standard wooden reel.

The 104-in.-dia reels are made from Alcan B54SO alloy sheet ⅛-in. thick for the flanges, Alcan B45SH21 alloy ⅜-in. thick drum, and a Tee tire of Alcan 65ST6 alloy extruded section.

The 84-in.-dia aluminum reels, made of Alcan B54S alloy sheet with an Alcan 65ST6 alloy "I" beam tire, weigh 400-lb.

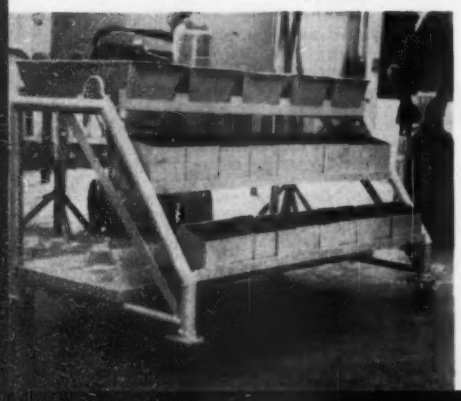
The new reels were designed to fit snugly into the standard railway freight car—12 reels to the car. Also, the new aluminum reels were subjected to severe tests covering every circumstance a reel may encounter under regular use: falling off a transporting vehicle when fully loaded; having another reel dropped upon it, etc. The all-aluminum reels stood up better than the wooden ones and at least as well as the steel units.

Argon Electric Welding Co made the original 300 reels (38-in.-dia for ACSR cable) for Quebec-Hydro Corp's Bersimis tension-stringing project.

The Aluminum Co of Canada Ltd's Shawinigan fabricating plant is turning out 84-in. reels at production rates.

Rig Holds Small Parts During Overhaul

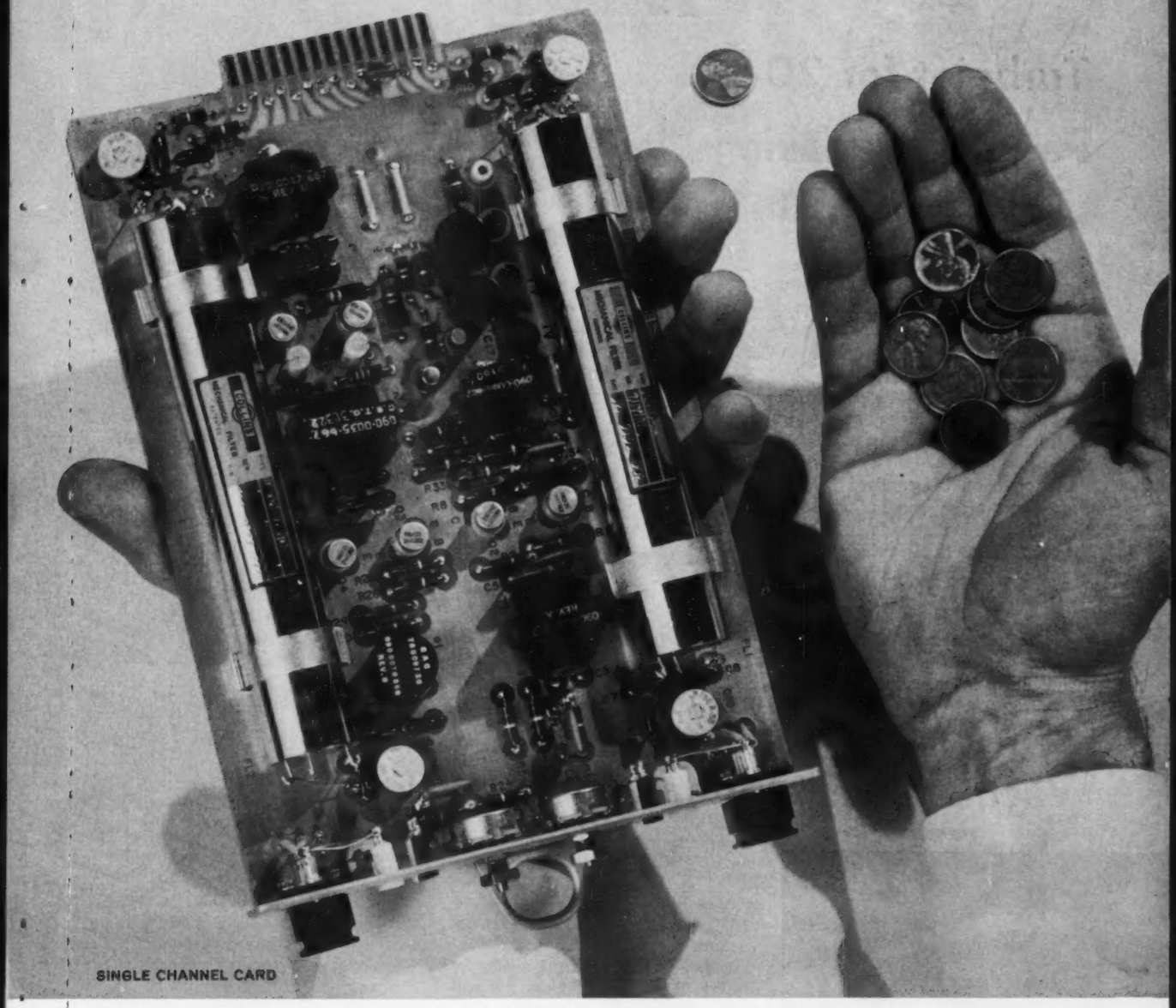
HOMER MOSS, Maintenance Foreman, Denver City Plant, Southwestern Public Service Co, Denver City, Texas



Convenient storage, better housekeeping and safety during overhauls of main units are promoted at the Denver City Plant of Southwestern Public Service Co through use of two storage rigs for bolts and small parts. Each rig provides a handy place to keep these smaller items right next to the larger pieces, insures against their being scattered and lost, and keeps the small, round and sharp parts from getting underfoot during maintenance work.

Each storage rig is about 6-ft long, 4-ft high and 4-ft wide at the widest point. A tubular steel frame, mounted on casters, provides an upper shelf for five large standard-type bolt pans. Nine pans each on two rows were made in the plant shop from 14-gage rolled iron, formed and welded. Caster-mounting permits the rig to be wheeled right into the desired position. Lifting eyes were added to each rig so that it can be lifted by the plant crane and carried from the machine shop to the turbine floor or elsewhere.

CUTS POWER COST **90**%...SPACE BY 80%



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Now... the freedom of maintenance and reliability inherent in transistorized equipment, at a saving of up to 90% in power and 80% in rack space over tube equipment. This is Collins new MX-106 fully transistorized carrier. Either in microwave, wire or cable systems — or any combination of these — the new multiplex is compatible with Collins MX-103, Western Electric L-Type, CCITT, and other carriers. Its design permits easy and economical expansion to meet changing requirements. For details, write Collins Radio Company, Texas Division Sales, 1930 Hi-Line Dr., Dallas 7, Texas.

COLLINS MICROWAVE AND CARRIER

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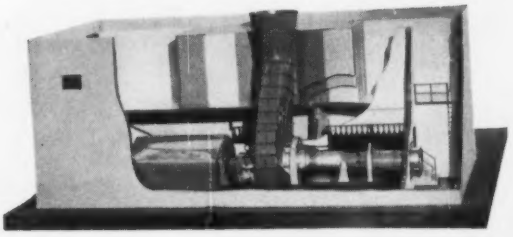
Turbojet for 20-Mw Packaged Peaking Plant



One of the original steps taken by Britain's Central Electricity Generating Board to reduce peak loads was the conversion of the Proteus turboprop-aero-engine, in production for the Britannia airliner, to drive a 2.5-Mw generator. This experiment, by Bristol Siddeley Engines, Ltd, is said to have been entirely successful and has led to the production of standard 3-Mw, Proteus-powered generating sets, two of which are already in use by the South Western Electricity Board at Princetown and Lynton.

These sets have a number of characteristics which, it is said, make them particularly suitable for peaking duty. Described as relatively inexpensive, small, light and relatively free from vibration, they can be housed in small buildings on light foundations—a mobile version is available. Operation is entirely automatic and suitable for remote control so that they do not need to be manned and, in fact, require to be visited only once every three or four months for minor maintenance. It is said that no warming-up period is necessary and the plant can go on to full load, within two minutes of starting up.

The success of the 3-Mw turbogenerator prompted Bristol Siddeley to carry out a market research on the whole subject of peak lopping with gas-turbine-powered equipment. Their estimates showed that costs per kilowatt would be reduced as the output of the set was increased. Accordingly, BS is building a 15/20-Mw set, using the Olympus turbojet aircraft engine as a gas generator to drive a free turbine, coupled directly to the generator. This plant is to be used as a peak shaving unit and appears to be of the optimum size for utilizations up to about 1,000 hours per year. The Olympus has established an excellent reputation for reliability and long life as the powerplant used in the Avro Vulcan V bombers of the Royal Air Force.

One 20-Mw set has been ordered by the Central Electricity Generating Board and two units have recently been ordered by Philadelphia Electric Co.

'Vacuum-Cast-Ingot' for Turbo Forgings

116-TON SHAFT, forged from a 12-in.-dia, 260-ton ingot, the largest ingot ever cast in a vacuum by Bethlehem Steel, will be used on General Electric Co's turbogenerator, as recently ordered by the Tennessee Valley Auth.

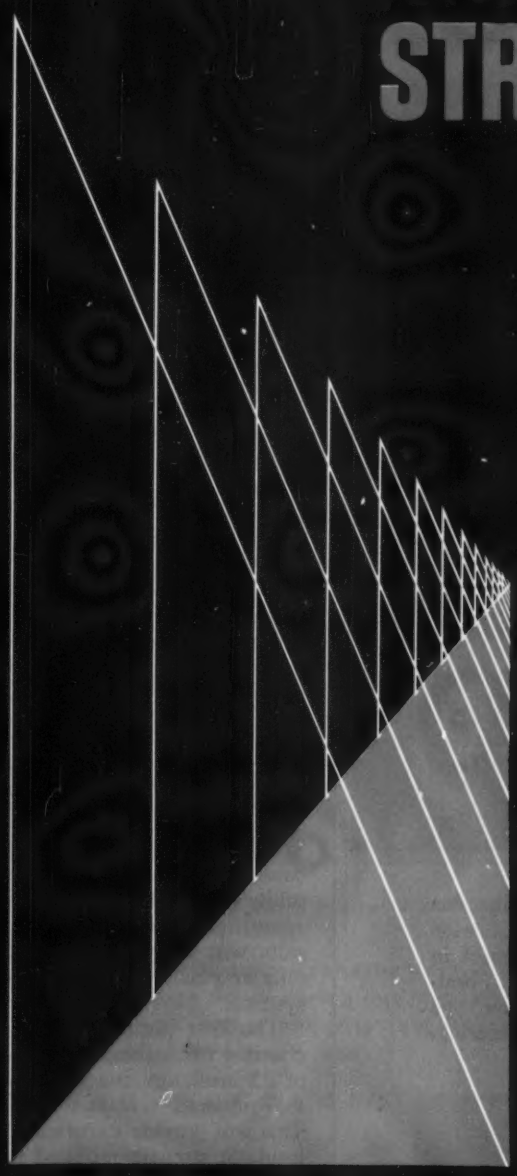
Bethlehem Steel Co is now supplying all steam turbine rotor and spindle forgings, and turbine powered generator shaft forgings from vacuum cast steel.

It is claimed that through vacuum casting, Bethlehem reduces the volume of hydrogen and other gases in the ingot to a relatively harmlessly low level. As a result, large press forgings now can be forged from sounder, tougher and cleaner ingots with the flaking or micro cracking practically eliminated.

While the processing and subsequent heat treating of forgings may reduce hydrogen in the exterior portions of the air cast ingot, the hydrogen content at the interior remains at a high level. In vacuum cast steels, however, the low hydrogen content is found throughout the ingot cross section. Besides virtually eliminating flaking or micro cracks, the removal of hydrogen in the vacuum pour greatly minimizes embrittlement tendencies in larger forgings.

The demand for press forgings for severe service applications being made of vacuum cast steel has necessitated the doubling in size of Bethlehem's installation. Two additional vacuum degassing chambers have now been installed capable of producing ingots 120 in. in diameter and weighing 535,000 lb. In all, Bethlehem operates five vacuum degassing chambers capable of servicing electric furnaces producing ingots from about 7 to nearly 270 tons. It is believed that the installation is currently the largest of its kind.

(*More News of Manufacturers, p* 48)



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Equipment designed and manufactured to highest quality standards to help you realize greater profits in the growing street lighting market.

LUMINAIRES

- Holophane glass refractors with prismatic construction
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- Cadmium cell type (tubeless)
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No cleaning maintenance; easily relamped. Incandescent or mercury vapor (with built-in ballast) types, with or without photoelectric control.

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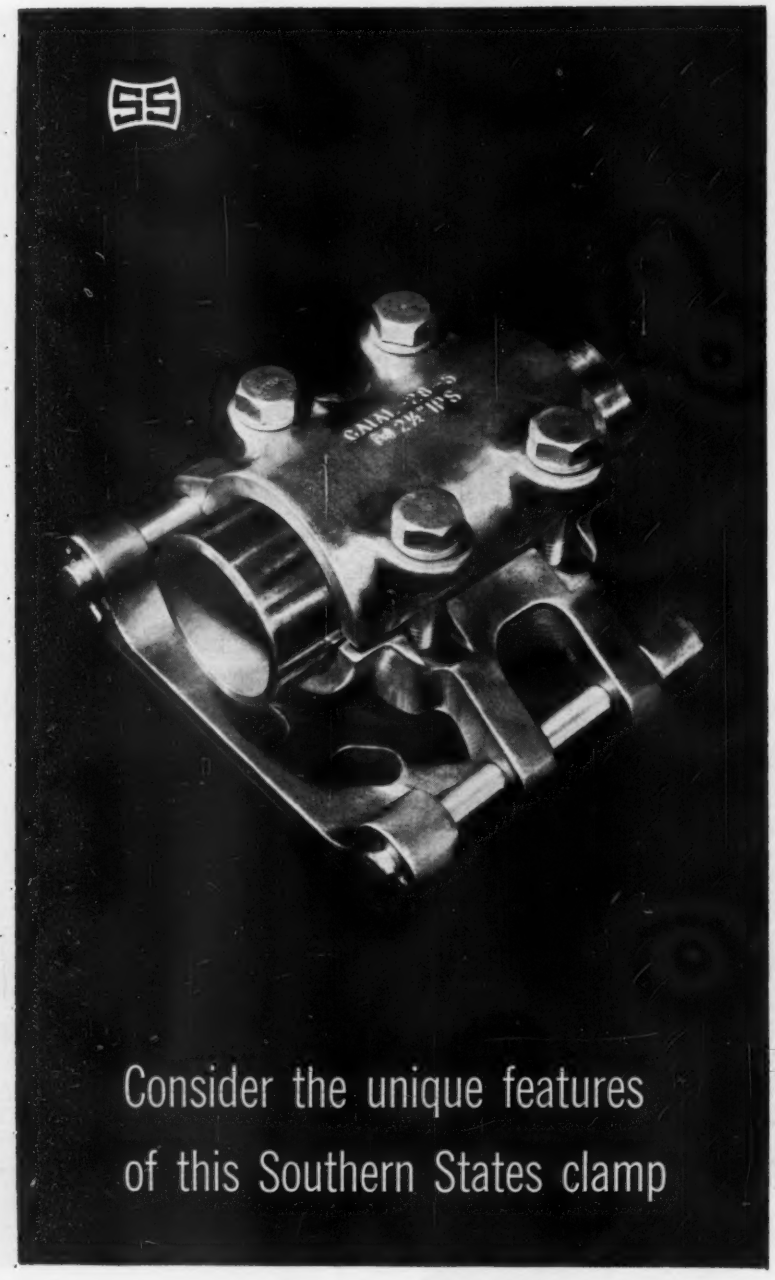

This exclusive design offers many advantages in a sliding bus support clamp: two stainless steel excursion rods... wide support to provide high cantilever strength... movement in only one direction — no pivoting or side chatter... heat-treated, high strength aluminum... anodized bolts. The Type CAIAL is another example of Southern States engineering.

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA Dominion Cutout Co., Ltd., Toronto

FLASHOVER ON INSULATOR STRING is produced by 3 million v of artificial lightning at GE's Project EHV. Artificial lightning is produced by impulse generator located within nylon bubble

Lightning and Switching Surges Bomb Project EHV

Up to 3 million v of electricity, produced by an impulse generator, flashes over insulators at General Electric Co's EHV prototype transmission system at Pittsfield, Mass.

Purpose of the testing, according to GE, is to determine the attenuation of impulses on EHV lines, measure the effect on station apparatus, and make special tests on insulators and other electrical components.

The bolts of electricity are being applied at 1 to 2-min intervals weekly to give accurate readings in all types of weather conditions. The object of these and other studies is to duplicate conditions that might cause interruptions on an electric utility's extra-high-voltage line in commercial service. The test results will be available to electric utilities planning extra-high-voltage systems.

The first portion of the testing consists of flashing over a string of 22 insulators attached to one of the project's transmission towers. This will provide statistical data on insulator strength required to withstand switching surges and the devastating effects of lightning.

(*More News of Manufacturers, p* 50)

In the interest of security we literally turn things upside down looking for leaks.

Yes, Moloney Distribution Transformers are actually turned upside down during our Inversion Test. They must pass this security test which detects any leaks due to faulty seal.

When you purchase Moloney Distribution Transformers, you can feel secure from outages and frequent maintenance problems caused by moisture and sludging . . . two very subversive elements.

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Now—A *unitized* power pack for *maintenance free* switchgear tripping and control!

Utilities and industrial plants can greatly increase their margin of reliability and protection for switchgear and control equipment by using C & D's *AutoCal** *unitized* Power-Pack.

Here's a dependable, high-capacity power package specifically built for tripping and control that pairs a simple, compact, C & D *AutoReg*® Silicon charger with powerful, lead-calcium grid control batteries. No adjustment or manual switching is required.

The charger is a completely automatic, constant voltage, current limiting unit. It regulates DC output voltage within ±1% in floating range over an AC input variation of ±10%. The silicon rectifying element has no known aging characteristics. Consequently, there are no aging taps and the attendant adjustment of these is eliminated. *AutoCal* has no moving parts and it utilizes a standard 115 volt, 60-cycle, single phase outlet as a power source.

PlastiCal® batteries** have extra thick positive plates (0.266″). They provide a high one minute rate. Lead calcium grid batteries require 1/5 to 1/10 as much current to maintain a fully charged condition as do conventional batteries. Consequently, there is so little electrolysis of water occurring that the batteries need be watered only once a year.

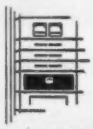
The combination of a C & D *AutoReg* charger and *PlastiCal* battery gives you self-protected charging . . . instantaneous peak power on demand . . . and long trouble free life.

Get the full details—write for Bulletin AR-102 today!

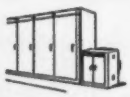
CHOICE OF MOUNTINGS

CUBICLE MOUNTING. Most popular method mounts *AutoCal* on the door of associated breaker cubicle.

WALL MOUNTING. Charger may be wall mounted near bank of indoor switchgear.



RELAY RACK MOUNTING. Charger is available with front panel for standard 19″ relay rack.



WEATHER-PROOF OUTDOOR MOUNTING. Both charger and batteries fit in a weather-proof cabinet for use with outdoor switchgear.

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**Trademark, C & D Batteries Div. The Electric Autolite Co.*
***Designed for 25 year life*

MANUFACTURERS BRIEFS

• **Leeds & Northrup Co** has received a second order from Public Service Electric & Gas Co, of N. J., for an additional LN 3000 computer system. It will be used at Mercer Generating Station to accomplish complex boiler-turbine unit performance calculations and display operating guides to aid in optimizing the performance of the two 320-Mw generating units at this new Public Service plant. Delivery will be in about one year. The application duplicates an installation of an LN 3000 computer assembly to be made shortly at the Bergen Generating Station.

• **English Electric Corp** was today incorporated in the state of Delaware as a wholly-owned subsidiary of The English Electric Co, Ltd, of London, Eng. The new corporation consolidates the US activities of the English Electric Export and Trading Co, Marconi's Wireless Telegraph Co, Marconi Instruments and the English Electric Valve Co—all of which have been represented here for ten years or more.

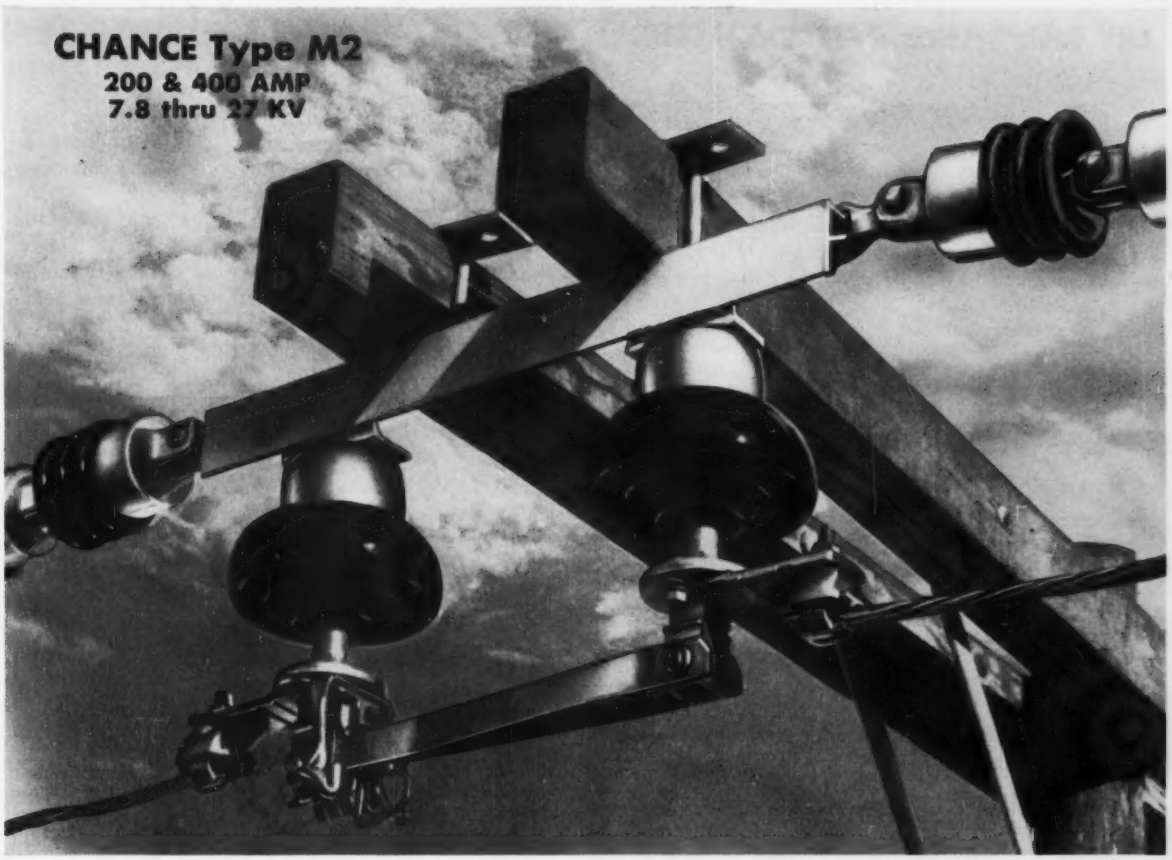
• **Reynolds Metals Co** has purchased the Ford Motor Co building and plant site at Chester, Pa., the two firms announced recently. Reynolds bought the facility for $2.2 million for manufacture of insulated wire and cable products. The building, on the Delaware River, has 650,000 sq ft of floor space.

Letters (*Continued from p 5*)

the luxury of such an insignificant voltage step as 500 kv. From the national standpoint, nothing less than 700 kv should be acceptable for the future, particularly when we realize that regional systems are a must and that many major system mergers are long overdue . . .

E. T. Hughes
Arlington, Va.

►It is our position that the unification of voltages which Reader Hughes proposes would be a desirable achievement. But we hold that it can best be reached by a progressive lengthening of the increment between voltages and not in any one single grandiose step such as Hughes suggests.



NEW

Hookstick Disconnect Switch coordinated with distribution level equipment

To order, see Section 250 in your Chance Catalog, ask your Chance Representative, or write us.

A. B. CHANCE CO.
CENTRALIA, MISSOURI
A. B. Chance Co. of Canada, Ltd., Toronto

C561-12

Designed specifically for pole-top applications, this new Chance disconnecting and sectionalizing switch has the same withstand ratings as fuse cutouts, pole-top regulators, reclosers, and transformers for application to "distribution level" circuits.

LIGHT BUT RUGGED. Linemen appreciate the light weight of the M2 Switch (the 15 KV rating weighs but 40 pounds.) This is due to aluminum cap and pin on the insulators and to design simplicity. The M2 is mechanically strong. A rigid blade and built-in blade guides prevent jamming the blade into an improper closed position, even under considerable side thrust. A positive latch and pry-out is provided on the blade.

SIMPLE TO INSTALL. The M2 Switch can be mounted vertically or underhung, on single or double crossarms. The base has slots separate from the insulator attachments to permit mounting bolts to be placed up close to the crossarm without interference with the insulator cap. There are no complicated adjustments to be made.

SURE AND SAFE. This switch is a reliable conductor when closed and a safe isolator when open. It will operate under the widest range of environmental conditions without damage to the switch or hazard to the operator.

DESIGN COORDINATED WITH DISTRIBUTION REQUIREMENTS. Open gap spacing for each voltage rating coordinates with the impulse withstand values of the insulators. Current ratings are based on test specifications of NEMA Standards for power switching equipment. The M2 Switch is available in both 200 and 400 amp. sizes for 7.8, 15 and 27 KV ratings.

head would have required considerable increase in the porcelain insulator diameter over that of the 230-kv design, were the conventional construction used. Large porcelain diameters are quite acceptable in the EHV field for low-pressure application. But high operating (200 psi nominal) and factory test pressures, up to 500 psig and higher, necessitated a double-pressure-zone pothead.

Condenser grading for control of the distribution of voltage in pothead terminations is not new. Yet some of the construction and assembly features of the 345-kv condenser pothead are novel in the terminating field.

The relatively uniform voltage gradients along the outside surface of the porcelain insulator obtained by condenser grading permits the use of smaller bore and over-all diameter porcelains. Unfortunately, these benefits are not without some disadvantages of relatively high design and operating dielectric stresses within the condenser grading assembly.

The doughnut-type condenser was preferred to the coaxial for these reasons:

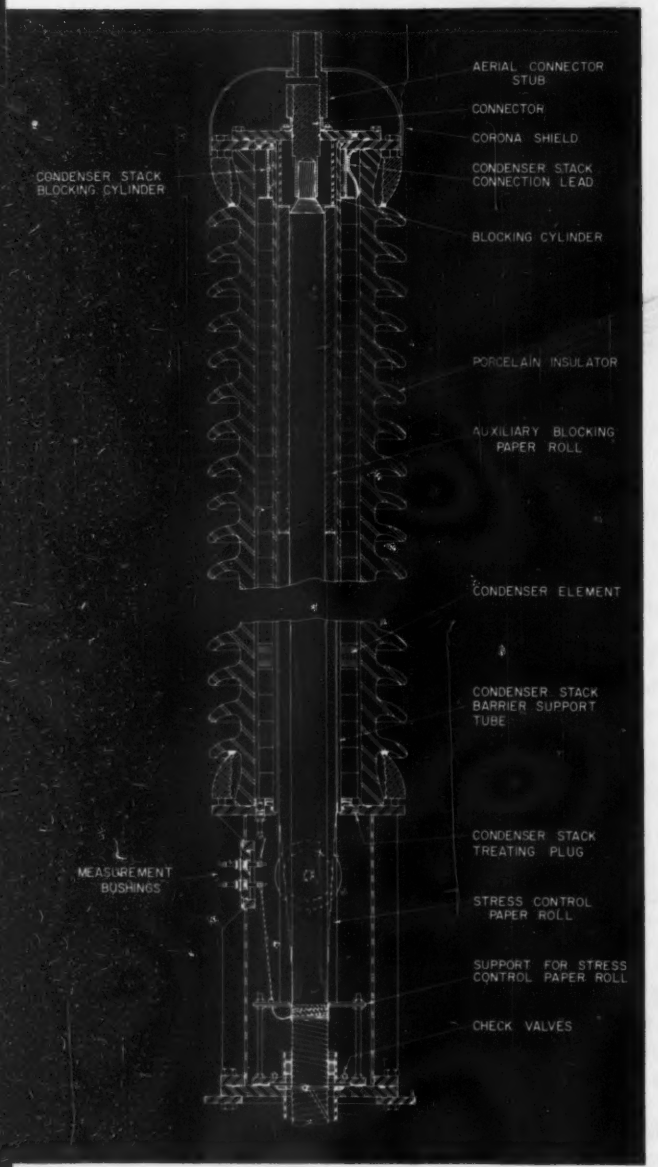
1. Individual elements may be readily subject to routine power factor and capacity measurements at voltages above normal operating potential.

2. Inherent manufacturing tolerances in the elements may be used to an economical advantage in obtaining capacity grading.

3. Over-all manufacturing costs are lower.

4. A limited number of element designs can be used to cover a considerable range of different cable conductor sizes.

A paper roll, 80 in. long, obtained a very gradual transition from cable diameter to the bore of the barrier tube and maintained minimum radial dielectric discontinuity until the radial voltage gradient between barrier support tube and cable reached a conservative value. This eliminated application of several small rolls in series and "fill in" with hand-applied tape insulation, thereby reducing over-all insulation time. The stress-relief cone was made in the factory by attaching metal foil strips to the paper in such a manner that the proper contour could be obtained with the roll applied as a cylinder.



EHV POTHEAD—G&W terminal has 1,300-kv BIL. Doughnut-type condenser obtains relatively uniform voltage gradients along the porcelain insulator's over-all outside surface

Tests Confirm Principles, Parameters

Vertical weight of the roll is supported at the bottom by an adjustable platform. Clearance between the paper roll and the bore of the phenolic barrier support tube was kept as small as possible to maintain a low radial dielectric stress in this oil zone. An auxiliary paper roll blocks the stress-control paper roll at the top, preventing movement when a pressure differential develops across the roll.

The 1½ x 40 impulse tests, the 1-min and 6-hr 60 cps withstand tests, and the long-time load cycle tests over thousands of hours were completed on prototype and final design potheads to confirm the basic principles and design parameters.

The influence of field installation was evaluated before the pothead's design was established. The impregnated condenser-stack assembly was factory installed as an integral part of the pothead. This required a barrier tube to support and maintain a temporary seal of the condensers during shipment and actual field assembly. A two-piece cap and hand holes in the body facilitate installation.

The reduction in field-assembly time, factory control of assembly, and maintenance of factory impregnation of condenser stack minimized installation time.

Assembled Parts Speed Pothead Installation

E. F. HUSTON, Development Engineer, Ohio Brass Co, Mansfield, Ohio

Designing a suitable pothead for the 345-kv Cornell tests posed for Ohio Brass Co this initial problem: What design features would remove the risk of damaging exposure of the cable during the longer time required for field installation of the larger, more complex cable terminals?

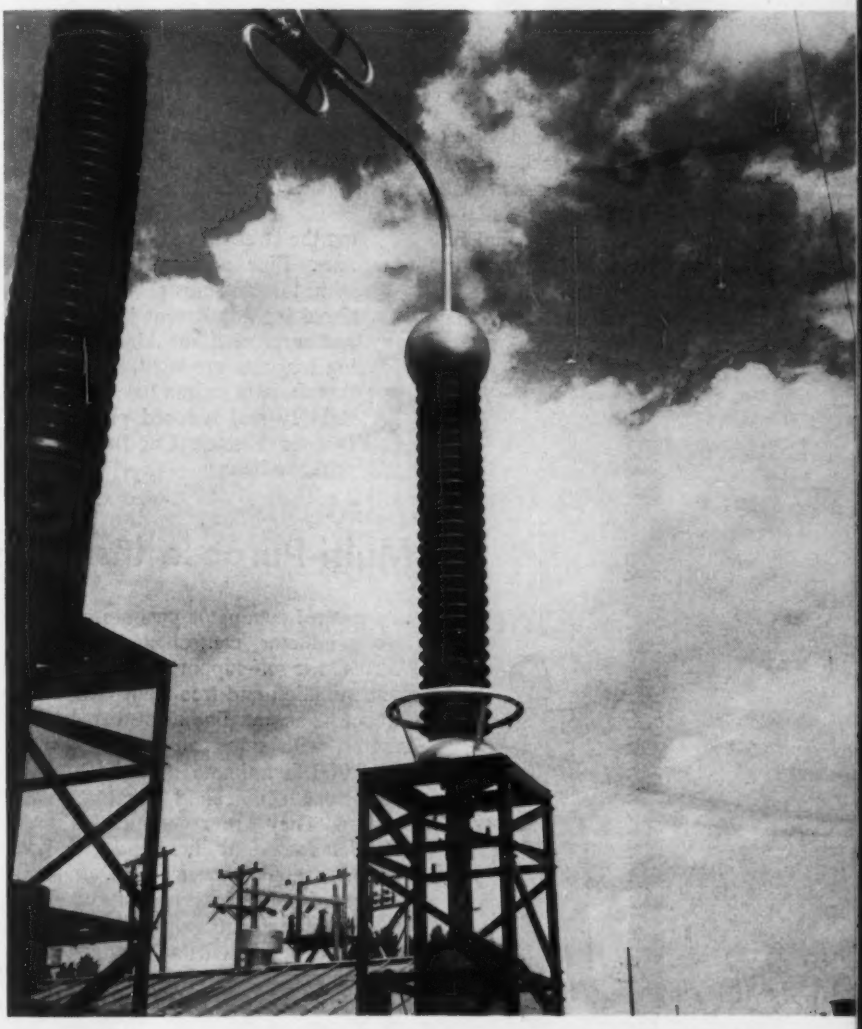
Ohio Brass's extensive use of pre-assembled components shortened the pothead installation time and incidentally the cable exposure time. The final design had these major features:

1. Capacitor grading for positive gradient control

2. Sealed capacitor units not exposed to atmosphere during field installation

3. Factory-produced, stress-cone shape contained integrally in the lower paper build-up roll

4. Pre-assembled components to reduce field installation time and cable insulation exposure time.



EHV POTHEAD—Ohio Brass's pothead consists extensively of pre-assembled components to shorten installation time and incidentally cable exposure time

Assembled on Paper Tube

The high oil pressures in some of the cable installations made desirable the smallest possible diameter of the pothead porcelain housing. The porcelain had to confine the pressures mechanically and yet be large enough to hold the build-up and capacitors. A factory-produced, stress-cone shape and a factory-sealed housing with series connected capacitors permit precise, positive gradient control. The stress cone in the build-up and the capacitor stack do their jobs easily within the diameter limitation.

The capacitors are doughnut-shaped, assembled on a paper tube which closely fits over the cable build-up roll. The Ohio Brass factory wraps the capacitors and forms the tubes to precise specifications.

The factory stacks the capacitors, connects them in series, installs them in the porcelain housing, oil-impregnates and seals them. They remain untouched throughout field installation.

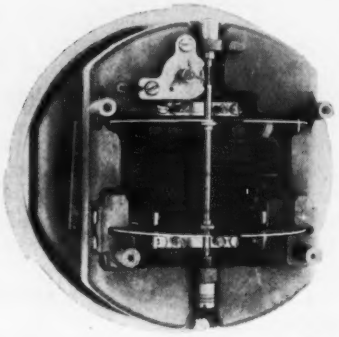
A build-up roll with the stress cone integrally wrapped in the lower end was introduced to overcome the problems of tedious hand shaping of the stress cone in the field. This has greatly simplified field installation, as the stress cone is installed by merely installing the lower build-up roll. Furthermore, the stress cone remains the ideally shaped, logarithmic curve produced on the precision wrapping machine in the factory.

During the factory wrapping of the paper build-up roll, the stress cone is included by bonding a ribbon of aluminum foil to the paper roll. A special paper-winding machine precisely sites the foil on the roll and controls wrapping tension accurately. Were the paper roll sectioned, the resulting logarithmically shaped curve would be more evident.

The above features incorporated in these 345-kv capacitor graded potheads lend themselves to other voltage levels. Although even higher voltage potheads with these features have been tested in the high-voltage laboratory and will undergo tests in several cable manufacturers' laboratories, and although the 345-kv potheads represent the highest voltage terminal in field use in this country, the design has been in continuous service on lower-voltage cable systems for some time.

New Equipment

Polyphase Watthour Meter . . .

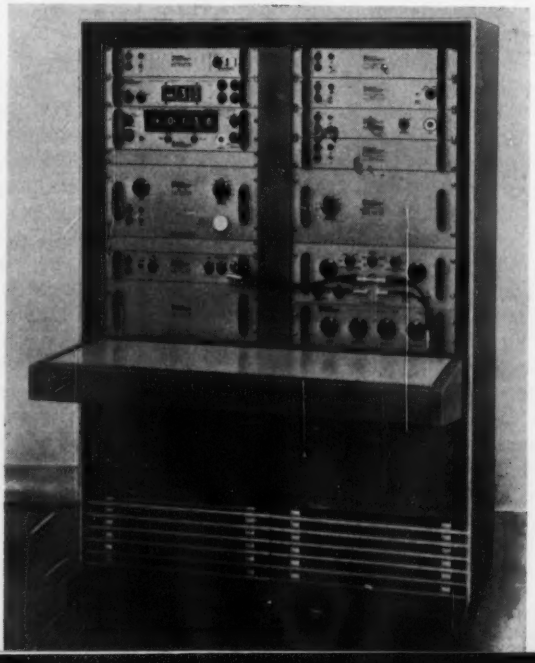


. . . is a two-stator device to meter 3-wire network service. It is claimed that construction has been simplified in the MH-1S by eliminating conventional full-load and light-load adjustments, and by keying together the potential and current electromagnets in a die-casting operation for assembly directly to the back of the frame. Initial calibration of the meter is made by adjusting the strength of damping magnets. Fine adjustment is made with torque screws. A conventional lag adjustment is provided and surge resistant Alnico damping magnets are used. It is said that the new design has increased stability and reduced price.
Duncan Electric Co, Inc, Lafayette, Indiana

Multi-Purpose Insulator . . .

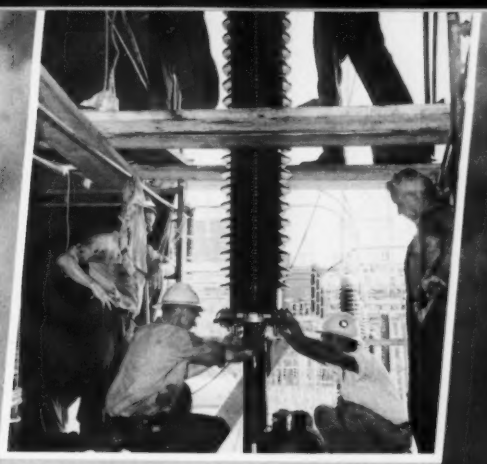
. . . control conductor position on hv lines where positive conductor control and clearance are required. "Struts" are self-supporting, puncture-proof, resistant to contamination and free from radio and television interference. The new line of insulators are available in five lengths, with standard strength porcelain body rated at 15,000 lb ultimate strength in tension or in a new high-strength porcelain rated 25,000 lb ultimate in tension. They are recommended in suspension construction for controlling conductor position on jumper supports, angle construction, conversion to higher voltage of short crossarm structures and for tangent construction. Struts, singly or in combinations, take compression and tension loading, to match the electrical characteristics of the suspension string.
Lapp Insulator Co, Inc, Insulator Div, Le Roy, N. Y.

Capacitance Monitoring System

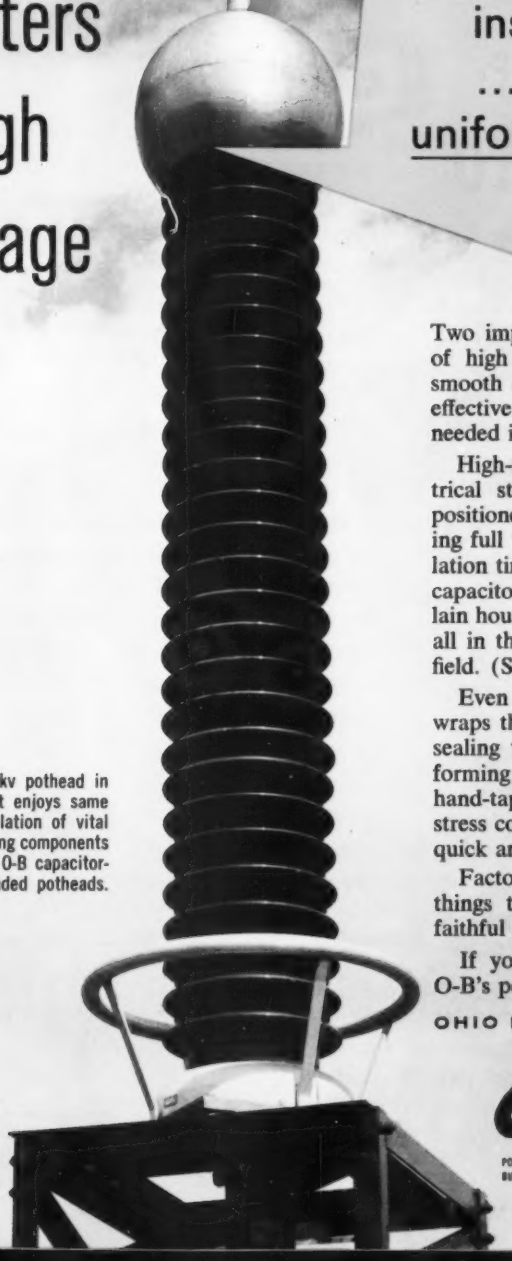


. . . automatically measures capacitance, dissipation factor, and leakage current and records this information on high-speed, punched paper tape. Model 10001 is a medium-speed digital system consisting of an input scanner, input preamplifiers, impedance comparator, digital voltmeter and output control devices. Input scanner provides for automatic scanning of 100 capacitors either in a continuous cycling mode, a one-cycle-and-stop mode, or a manual one-channel-at-a-time mode. Scanner also will provide appropriate precharging for leakage current measurements, allowing all capacitors to be charged for one minute and measured at the rate of ten per minute. The impedance comparator is totally transistorized.
Electro Instruments, Inc, 8611 Balboa Ave, San Diego 11, Calif.

O·B Pothead masters high voltage



...Offers quick practical installation ...assures uniform gradient



This 345-kv pothead in Cornell test enjoys same precise installation of vital electrical grading components as all O-B capacitor-graded potheads.

Two important factors make the O-B Pothead master of high voltage in terminating underground cables: smooth distribution of line-to-ground voltage and fast, effective installation. Both help insure the exactness needed in a high voltage pothead.

High-magnitude capacitors uniformly grade the electrical stresses in the pothead. These capacitors are positioned over the entire upper end of the cable, making full use of the pothead height. To save field installation time and to assure a factory-quality product, the capacitors are manufactured, installed within the porcelain housing, connected, oil impregnated, and tested . . . all in the factory. They need never be touched in the field. (See photo above)

Even the stress cone offers factory-exactness. O-B wraps the stress cone inside the lower build-up roll by sealing to the paper an aluminum foil strip, perfectly forming a logarithmic curve. No more time-consuming hand-tapering of the build-up; just slip the special stress cone build-up roll over the cable and tighten. It's quick and accurate!

Factory-produced components leave less chance for things to go wrong during installation and establish faithful reproduction of the pothead design.

If you are planning cable installations, ask about O-B's pothead.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

10109-H

OHIO BRASS MANAGEMENT REPORT

ANTICIPATING CUSTOMER NEEDS TAKES US FROM "MULE JEWELRY" TO 345-KV POTHEADS

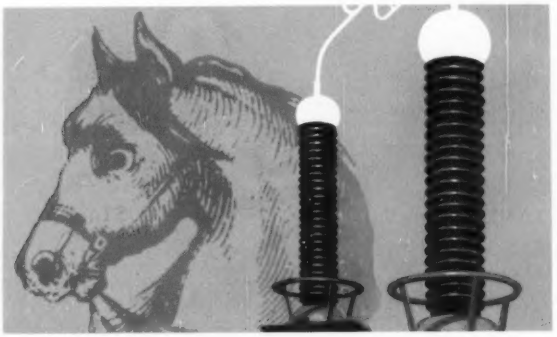
BY GEORGE L. DRAFFAN

CHAIRMAN, OHIO BRASS COMPANY

On my desk lies one of our original products—a simple brass harness buckle—or a piece of "mule jewelry." I keep it as a reminder that nothing stands still in this world, and more to the point, the needs of customers change constantly. Ohio Brass long ago quit making mule jewelry, but we are constantly looking for "harness buckles" in our present product lines. What are we making today that will be no longer needed tomorrow? As a customer or prospective customer, you may be interested in ways we are trying to anticipate your needs of tomorrow.

OUR CERAMIC RESEARCH IS BASIC RESEARCH conducted by a team of men with no day-to-day commercial responsibility. We have instructed them to take the broad approach—to consider Ohio Brass as a manufacturer of electrical insulation, not just electrical porcelain. If porcelain isn't the best material (our research still indicates its great superiority), then we want to find and use the material that is best. If the porcelain insulator is to become tomorrow's "harness buckle," we want to be the first to know.

EXTRA-HIGH VOLTAGE DEVELOPMENT is the "how high tomorrow" department. We have already tested materials for 750-kv transmission, and could readily make studies for a million-volt line.



If there is need to go higher, we'll have the facilities available and the know-how for the testing.

WE CAN OFFER several worthwhile results of immediate value. New insulator and hardware combinations developed for multiple-conductor systems make possible reductions in tower height, narrower right-of-way, reduced phase spacing for increased transmission capability, and closer coupling of phase and ground wires for improved lightning performance. Realizing that EHV must also go under ground, we have supplied 345-kv potheads for tests at Cornell University sponsored by the Association of Edison Illuminating Companies and the Edison Electric Institute.

MECHANIZATION AND EXPANSION MUST GO ON even in a depressed market. We must be ready to supply the type of products your company will need in ten years, and be ready to supply them in increased quantity to take care of your doubled capacity. We have invested heavily in mechanization and made other fundamental changes in factory procedure—all designed to increase both quality and capacity and keep unit cost low.

WE BELIEVE strongly that it's our duty to keep our entire organization—sales, engineering, factory—oriented toward the needs of the customer. We must keep the "mule jewelry" out of our product lines and out of our thinking.

HOLAN

10147-H

OHIO BRASS COMPANY, MANSFIELD, OHIO

Porcelain Insulators – Line Hardware – Capacitors – Lightning Arresters Bushings – Holan Truck-Mounted Power Devices and Bodies – Bronze Valves

10109-H

Electrical World

MAY 1, 1961

Management Newsletter

Business Plans For Capital Spending (billions of dollars)

	1960	1961*	% Change	Preliminary Plans 1962	1963	1964
All Manufacturing	$14.48	$14.09	− 3%	$13.92	$13.60	$13.71
Mining	.99	1.03	+ 4	.94	.88	.91
Railroads	1.03	.69	−33	.72	.71	.73
Other Transportation & Communications	5.07	4.80	− 5	4.56	4.44	4.84
Electric & Gas Utilities	5.68	6.13	+ 8	5.74	5.82	5.92
Commercial	8.44	8.61	+ 2	8.27	7.61	7.23
ALL BUSINESS	**35.69**	**35.35**	**− 1**	34.15	33.06	33.34

*Estimated
Source: McGraw-Hill Department of Economics

Business Boosts Spending Plans

American business has raised its sights since last fall. In October, capital spending for 1961 promised to be down 3% from the 1960 figure. But now, the reduction has been shaved to 1%. And preliminary plans for future spending already are running close to this year's estimates. As more and more companies firm up their expansion programs, spending in the period 1962-64 will more than likely surpass this year's level.

A semi-annual survey made by the McGraw-Hill Department of Economics is the basis for these conclusions. Industry's replies to the department's questionnaire were received during March and early April, and are probably an accurate indication of business thinking at the present time. Companies included employ nearly eight million workers, about 40% of all industrial employment. Here's what the survey shows:

American business plans to spend $35.35 billion on new production facilities this year. This is only $340 million less than was spent last year, but still about $1.6 billion below the 1957 peak. Expenditures planned for 1962 and 1963 are only 5% below 1961, and spending estimates for '64 are already edging ahead of 1963. Several industries—nonferrous metals, autos, fabricated metals and instruments, chemicals, rubber, and petroleum—are planning investments in '64 that will be well above their 1961 outlays.

Generally, plans for more than one year ahead are considerably lower than those for the current year simply because future plans are incomplete. The fact that proposed expenditures beyond 1961 are already at a very high level would indicate that actual spending may turn out to be considerably higher. So, the preliminary plans revealed in this survey are definitely a bright omen for the future.

American manufacturing companies will spend $14 billion this year, and very nearly the same amount in each of the next three years. The petroleum industry, planning expenditures of $2.85 billion in '61, leads the manufacturers. It will put up about the same amount each year through 1964. Chemical manufacturers will maintain their present spending rate ($1.66 billion per year) through 1963, but in 1964, present planning indicates a sharp step-up in their capital outlays. Both machinery and auto companies will continue putting about $1 billion a year into expansion and modernization.

Electrical machinery manufacturers, including companies building electrical equipment and those producing appliances, invested 8% more in production facilities this year than they did in 1960. But advanced planning for the next three years indicates that they intend to cut back. So far, $620 million is earmarked for '63 against $730 million for '61.

Manufacturers Capital Spending Plans (billions of dollars)

	1960	1961*	% Change 1960-1961	Preliminary Plans 1962	1963	1964
Iron & Steel	$1.60	$1.18	−26%	$1.33	$1.04	$1.12
Nonferrous Metals	.31	.31	0	.35	.41	.46
Machinery	1.10	1.14	+ 4	1.09	1.11	1.13
Electrical Machinery	.68	.73	+ 8	.66	.62	.62
Autos, Trucks, & Parts	.89	1.01	+14	1.00	1.16	1.03
Transportation Equipment (Aircraft, Ships, R.R. eq'pt.)	.42	.40	− 5	.33	.30	.28
Fabricated Metals & Instruments	.95	.72	−24	.75	.81	.79
Chemicals	1.60	1.66	+ 4	1.58	1.60	1.74
Paper & Pulp	.75	.68	− 9	.60	.61	.62
Rubber	.23	.22	− 6	.23	.24	.24
Stone, Clay & Glass	.62	.59	− 5	.55	.55	.53
Petroleum & Coal Products	2.64	2.85	+ 8	2.88	2.82	2.88
Food & Beverages	.92	.99	+ 8	.97	.85	.85
Textiles	.53	.39	−26	.37	.36	.36
Miscellaneous Manufacturing	1.24	1.22	− 2	1.23	1.12	1.06
ALL MANUFACTURING	**14.48**	**14.09**	**− 3**	**13.92**	**13.60**	**13.71**

*Estimated
Source: McGraw-Hill Department of Economics

In non-manufacturing areas, electric and gas utilities are sinking over $6 billion this year, coming close to 1957's record of $6.2 billion. And they will keep going at this pace through the mid-'60's. Transportation and communication companies will invest $4.5 billion annually. Commercial companies plan to spend a record $8.6 billion reflecting the continued upswing in construction of new shopping centers, warehouses, and office buildings. But plans for these companies taper off as we move into 1962. Railroads cut their capital outlays by 33% during 1961, and plan to continue with lower expenditures during the next four years. Mining companies, which raised expenditures by 4% this year, will scale down plant and equipment investments during the 1962-64 period.

How will American manufacturers spend their $35.35-billion capital investment? Mostly in modernizing existing plants and equipment. The survey clearly highlights industry's growing concern with obsolescence. Increased emphasis on modernization has been evident since 1958, but this year manufacturing companies plan to spend a greater percentage of their investment to improve their existing facilities than in any previous year. In 1959, manufacturers spent 63% of their investment in improvement rather than in expansion. In 1960, the figure was 69%.

This year, it will probably reach 70%. And the effort to update plant and equipment will continue through 1964 with industry committing two-thirds of its expenditures to replacing obsolete machinery and buildings.

Conversely, the proportion of expenditures going to expansion of facilities is dwindling. In only one industry, chemicals, will additions to existing plant take better than a 50% bite of capital outlay. The reason for cutting back on new facilities is, of course, that present facilities are already excessive.

Overcapacity seems to be the keynote of American industry at present. Manufacturing companies were operating at 77% of capacity at the end of 1960. This is the lowest operating rate reported in any of the McGraw-Hill surveys, even below the pit of the 1957-58 recession when the figure was 78%. It is substantially below the 94% preferred operating rate which business men longed for in last year's survey. In many industries—steel, nonferrous metals, machinery, transportation equipment, rubber, stone, clay and glass, and petroleum refining— the gap between operating rates and preferred rates is 20 percentage points or more. With so much idle plant manufacturers will cut their rate of expansion during the next four years to about 3% annually, less than half of the post war average.

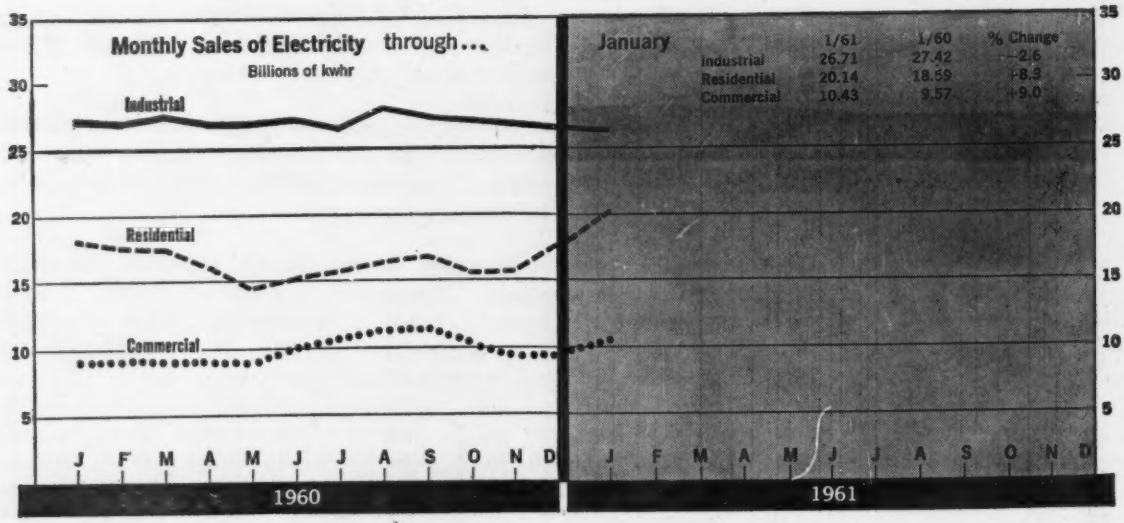
Decisions to expand plant modestly during the next three years despite present overcapacity hinge on expectations of increased sales. On the average, manufacturers anticipate that sales will increase 20% between 1961 and 1964. Nonferrous metals, machinery, autos, fabricated metals, chemicals, and stone, clay, and glass all expect to exceed the 20% sales jump. Only the transportation equipment industry anticipates a sales gain of less than 11%, but even these people have grounds for optimism. Their 1961 sales now promise to be 7% above 1960 instead of 4% below as they estimated last fall. Defense orders were a big factor in this switch, and increased defense spending seems in the offing for the next few years.

Industry expects greater sales growth than expansion of capacity over the period 1961-64. For manufacturers, sales will advance twice as fast as expansion, bringing them toward their preferred operating rates, and in many cases creating a need for even faster growth.

Regional patterns for new investment remain unchanged. The north central states will continue to get the lion's share, better than 27% of the national total. About 23% of American business spending for both this year and next will go to the middle Atlantic area. The South, including the states of Texas, Oklahoma, Arkansas, Louisiana, Kentucky, Tennessee, Mississippi, and Alabama, now ranks third in investment and has received a growing share of new capital over the past four years. In '61 and '62 it will take close to 22% of the nation's expenditure. Western and mountain states, which last year seemed to be forging ahead in their share of the US investment, now appear to be dropping back. The survey finds that they will receive a smaller proportion than they have in the past two years. This is also true of the New England and south Atlantic areas.

High point of the survey is that business seems to have brushed the '60-'61 recession aside. American industry is betting on the future of the economy, and continuing to invest in view of expected sales gains. Electric utilities would undoubtedly be happier if most of this investment were going into expansion. New plants are, of course, the key to industrial load growth while modernization of existing plant doesn't necessarily require increased electric power.

But in the past, new machinery has always created new production. Business' sizable investment in better equipment will put American products in a better competitive position abroad, and may be instrumental in expanding our overseas markets. It could also mean better products for less money here in the US with the resulting expansion in sales. So, from the long run viewpoint, electric utilities can find a lot to be happy about in industry's present thinking.



Power Statistics

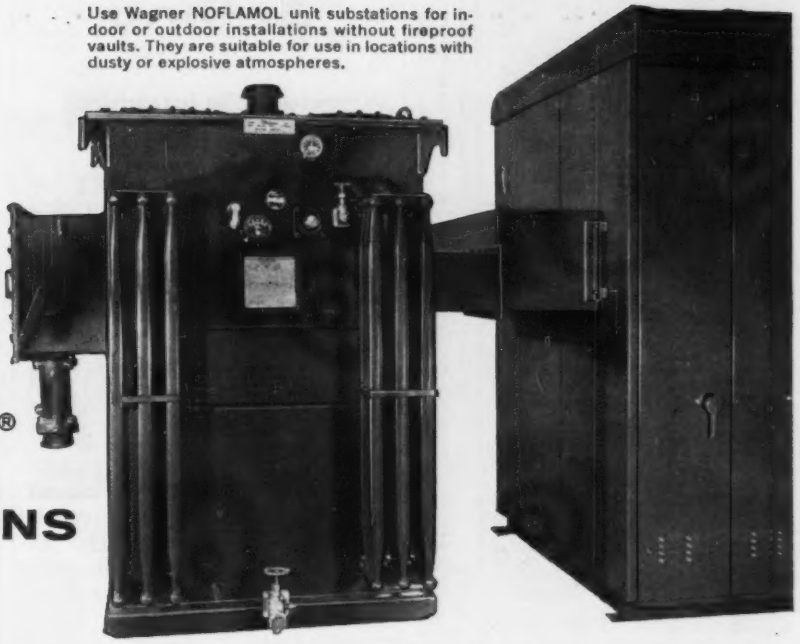
		Latest Month	Year Ago	Annual Change %
Capacity	Jan.	167.68	157.01	6.8
Est. Dec. '60 Peak (million kw)	Nov.	133.7	134.0	−0.2
Est. Dec. '61 Peak	Jan.	141.3	143.7	−1.7
Production—billion kwhr	Jan.	66.56	64.02	4.0
Hydro		10.76	13.01	−17.3
Fuel		55.80	51.01	9.4
Sales—billion kwhr	Jan.	60.05	58.23	3.1
Residential		20.14	18.59	8.3
Commercial		10.43	9.57	9.0
Industrial		26.71	27.42	−2.6
Other		2.76	2.66	3.8
Fuel Consumption	Jan.			
Coal—million tons		17.13	16.08	6.5
Oil—million barrels		10.27	10.62	−3.3
Gas—million cu ft		111.99	98.66	13.5
Net Income Class A & B Co's—$ million	Jan.	176.31	168.68	4.5
Residential Customers—millions	12 mos.	51.19	50.40	1.6
Revenue per kwhr	ended	2.47¢	2.50¢	−1.2
Avg kwhr per customer	Jan. 31	3,872	3,635	6.5
Avg annual bill		$95.64	$90.88	5.2

Business Statistics

Indexes:				
FRB Industrial Production (1957 = 100)	Feb.	103	111	−7.2
ENR Construction Cost (1949 = 100)	Apr.	175.6	170.6	2.9
BLS Cost-of-living (1947–49 = 100)	Feb.	127.5	125.6	1.5
New Orders for Machinery (1950 = 100)	Feb.	168	173	−2.9
NEMA Sales				
Insulation materials	Jan.	118	146	−19.2
Electric appliances	Dec.	77.0	91.3	−15.7
GNP—annual rate—$billion	4th qtr.	503.5	486.4	3.5

Significant Changes: Total sales up 3.7% over December despite the industrial slump. This is due to cold weather which raised residential sales by 13.3% over preceding month.

Use Wagner NOFLAMOL unit substations for indoor or outdoor installations without fireproof vaults. They are suitable for use in locations with dusty or explosive atmospheres.



For better power distribution Use

WAGNER® UNIT SUBSTATIONS

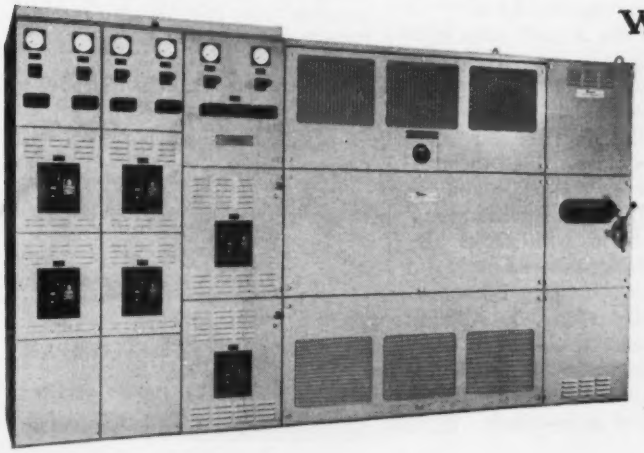
They are complete, coordinated load centers that give continuous, dependable power now... have plenty of capacity and flexibility for growth

An uninterrupted flow of power . . . that's the important thing in buildings, be they sprawling single-story factories or high-rise offices. And that is what Wagner® unit substations provide.

Designed to improve voltage regulation, and built to be troublefree, they are coordinated load centers that provide the flexibility needed to meet future load requirements. They consist of a proved Wagner transformer, universally acceptable interrupting devices, highly reliable air break switchgear, and metering equipment combined in perfect power packages. To simplify installation, they are factory tested and shipped completely assembled, ready for service. They economically deliver utilization voltage with shorter, less expensive conductor runs . . . lower maintenance costs with modern, protective enclosures . . . safeguard valuable equipment with adequate interrupting capacity. And, substation investment is protected because *one* manufacturer has responsibility for all component parts.

Wagner unit substations are built with transformers rated 112½ through 2000 kva, 3-phase, 60 cycle ratings with high voltages of 2400, 4160, 4800, 6900, 7200, 12000, 13200, or 13800 volts and low voltages of 240, 208Y/120, 480 or 480Y/277 volts.

Four types per NEMA standards are available: sealed dry-type; ventilated dry-type; oil-filled; and Noflamol (non-inflammable liquid-filled).



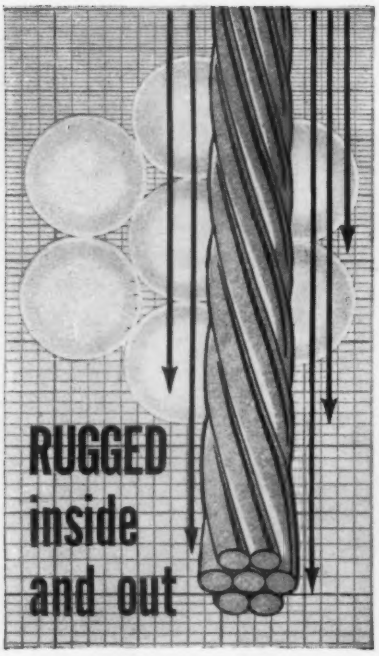
Wagner Electric Corporation
6456 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.

Your Wagner Sales Engineer

will be glad to help you plan any power distribution system. Get complete information on Wagner unit substations from him, or write us for Bulletin TU-152.

Use Wagner VENTILATED DRY-TYPE unit substations indoors. They perform efficiently in any reasonably dry, dust-free, well-ventilated location. Lightweight makes them ideal for use in multi-story buildings.

WT61-8A



Crapo
GALVANIZED
STEEL STRAND

Ruggedness and reliability are built into ***Crapo*** Galvanized Steel Strand from start to finish. The selected steel is carefully processed to make the final product strong and ductile —easy to handle, work and serve. The time-proved, tightly-bonded, tough zinc coatings resist the abuse encountered in construction and provide lasting protection against corrosion.

Crapo Galvanized Steel Strand is economical, too, both in first cost and ultimate cost.

A B C

CHOOSE FROM 3 COATING WEIGHTS

A coating weight for every need— ***Crapo*** Galvanized Steel Strand is readily available in Class A, B and C weights of coating. Class B coating is twice as heavy as the standard Class A coating; Class C coating is three times as heavy.

Contact the distributor of *Crapo* Galvanized Steel Strand near you for complete information!

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Selling

Westinghouse Introduces Thermoelectric Cooler

Westinghouse Electric Corp has begun production on a thermoelectric water cooler for office and home applications.

Over the past several years the company has shown several prototype appliance applications of thermoelectric principles but the water cooler will be the first product built on a production line basis.

In appearance the cooler resembles a standard, compressor-operated cooler, but within the cabinet the cooling system requires approximately 25% less volume. The 36-in. cabinet was retained because it places the water tap at a convenient level.

Westinghouse estimates one million American homes depend on bottled water for drinking purposes.

SELLING BRIEFS

First prize in the Ninth Annual Outdoor Advertising Contest went to Virginia Electric & Power Co in the design division. Award was given for utility's outdoor billboard, "Bright Idea, Electrical Gifts". . . **1961 room air conditioner** promotion kits have been distributed by NEMA to over 700 electric utility executives. Kit includes display streamer, direct-mail folders, and newspapers stories and pictures for daily newspapers. Cost: 60¢. A "Report to Utility Executives" in kit cites why room air conditioners should be promoted: Load averages 1,135 kwhr a year; adds night load to help level peaks; easy-to-sell additional units for present owners; circulates air without cooling to build spring and fall load; units for heating add load throughout year; low saturation; conditions consumer for electric heat; and year-round tie-in with Gold Medallion promotions . . . **Leasing of appliances** to apartment house operators will be offered by Admiral Corp's commercial electronics division. Company will offer electric refrigerators, air conditioners, electric ranges and dishwashers.

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Otter Tail Power Picks Chairman, President

Otter Tail Power Co has promoted Cyrus G. Wright to chairman and Albert V. Hartl to president. Wright was president and Hartl was formerly executive vice president.

Wright succeeded his brother, Thomas C. Wright, who retired as chairman but will continue as a director.

Coinciding with the new appointments, the utility announced plans to add over 35% to its total generating capacity in the next three years by constructing a 66-Mw lignite coal-fired steam generator.

C. G. WRIGHT HARTL

BLACK ▶

Black Promoted to Executive VP

Fischer S. Black has been elected executive vice president of Tampa Electric Co.

Black has been vice president-administrative since 1959. Before that he was publisher and editor of *Electrical World* for ten years. Earlier he had served with Nantahela Power & Light Co and Potomac Electric Power Co.

NEES Names Krause Executive VP and Hanson Financial VP

At New England Electric System, Robert F. Krause has become executive vice president and Harry Hanson has been named financial vice president.

Krause has been with NEES since 1948. He was named assistant to the president in 1950. In 1952, he became president of the Service Co and five years later was named president of the Power Co. A year and a half ago he assumed many duties formerly held by NEES Vice President Ralph Nock.

Hanson has been a vice president since 1959. Since 1935, when he became one of the youngest treasurers in the utility field, he has been treasurer of NEES and most of its subsidiaries.

KRAUSE HANSON

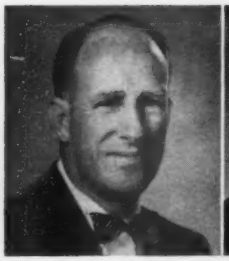
GT&E and Sylvania Electric Products Have New Presidents

Leslie H. Warner has been elected president of General Telephone & Electronics Corp and Gene K. Beare has become president of GT&E's subsidiary, Sylvania Electric Products, Inc.

Warner, formerly GT&E's executive vice president-manufacturing, succeeded Don G. Mitchell who was elected vice chairman of GT&E. Beare, who had been president of General Telephone & Electronics International Inc, succeeded Robert E. Lewis who resigned to become president of Perkins-Elmer Corp.

◀ WARNER (left) and BEARE

Hogg, Vence Named Atlantic City Electric Vice Presidents



HOGG

VENCE

Atlantic City Electric Co has named Robert W. Hogg as vice president and Anthony C. Vence as vice president, secretary, and treasurer.

At the same time, the company reported that new records for kwhr sales, systems peaks, and earnings were established last year. Energy sales were 6.8% more than in 1959, hitting nearly 1.6 billion kwhr. Revenues hit $40,231,677, an increase of 4.8%, and net income was up 12.7%.

More than $15.7-million capital expenditure was required in '60 for new and improved facilities and this year the figure is expected to reach $22.8 million.

Golden Appointed Vice President

Martin H. Golden has moved up to a vice presidency at Plymouth County (Mass.) Electric Co. He is also general manager of the New England Gas & Electric Assn subsidiary.

Golden has been in the utility business since 1926. He joined New Hampshire Gas & Electric Co, which was a NEGEA subsidiary, in 1936. In 1950 he was made general manager at Plymouth County Electric.

◀ GOLDEN

Allis-Chalmers Boosts Etherington

ETHERINGTON ▶

Harold Etherington has been appointed general manager of the atomic energy division of Allis-Chalmers Manufacturing Co.

He suceeds Roy M. Casper who recently was promoted to general manager of Allis-Chalmers' power equipment division (EW, April 24, p 156).

Etherington has been manager of Allis-Chalmers' nuclear power department for the last two years.

Nissel Joins Middle West Service as Vice President

Hans E. Nissel has joined Middle West Service Co as a vice president. This appointment is said to signify an expansion of services to utilities.

For the past ten years, Nissel has been an independent consultant to US public utilities on matters relating to operation, regulation, and engineering economics. He has also performed numerous assignments and held executive posts with public utilities in Europe and the Middle East. He is also the author of several books.

PERSONAL BRIEFS

Paul Scheerer has been named coordinator in the general offices' executive department of Monongahela Power Co.

Puget Sound Power & Light Co has appointed **Orland G. Hunt** commercial and industrial sales director; **Kennan E. Hollingsworth,** utilization engineer; and **William H. Heidergott,** contract supervisor, all in the general commercial and sales department.

Pacific Power & Light Co has named **Rex W. Beeman** administrative assistant to the general manager; **William G. Walker,** assistant to the Oregon division manager; **Joseph F. Wilson,** assistant superintendent of power; and **Robert R. McLagan,** power department maintenance supervisor.

California Electric Power Co's new assistant secretary-assistant treasurer is **R. C. Quarve.**

William Schmidlapp has become executive secretary of the Assn of Illinois Electric Cooperatives, succeeding **A. E. Becker** who retired.

The new chief engineer for Tillamook County PUD is **Norman Berg,** succeeding **Jack Madison** who became operations and maintenance superintendent.

(More News About People, p 66)

Easy to see why you get five-cycle interruption with General Electric one-tank breakers

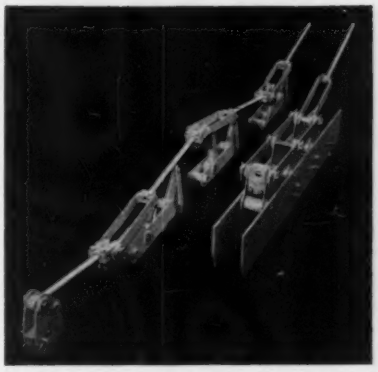
Compact linkage is the reason General Electric one-tank subtransmission breakers interrupt damaging faults in only five cycles—three cycles faster than industry standards for breakers of their class.

Faster interruption occurs because the mechanical linkage between the operating mechanism and contacts is shorter than for comparable three-tank breakers. As a result, contacts open in 2½ cycles. By the time another 2½ cycles pass, the arc is quenched completely by new filament-wound epoxy interrupters with superior mechanical and dielectric strength.

Five cycle interruption minimizes chances of line burn down, and reduces oil carbonization and contact wear.

In addition to five-cycle interruption, G-E one-tank breakers require less space and reduce oil-replacement and maintenance costs. They're rated 14.4 through 46 kv.

Ask your G-E Sales Engineer for more good reasons to use one-tank breakers. Section 493-08, General Electric Company, Schenectady 5, N. Y.



Shorter mechanical linkage results in five-cycle interruption for one-tank breakers. Linkage for three-tank breaker is at left.

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Clarence A. Dauber, civil and mechanical engineering division director, and **Edwin C. Cawrse,** steam power division general superintendent, have retired from Cleveland Electric Illuminating Co.

Kennecott Copper Corp has boosted **Robert G. Rhett** to general purchasing agent, succeeding **L. W. Shelton** who retired.

Leeds & Northrup Co has made **Daniel H. Schultz** president of its Canadian subsidiary, Leeds & Northrup, Canada, Ltd.

General Electric Co has appointed **Peter C. Van Dyck** general manager of service shops department, replacing **J. J. Durkin** who retired. **A. J. Gizzi** was named manager-manufacturing for all operations of the conduit products department. **R. F. Quinn** has become manager of GE's realigned agency and distributor sales development operation.

EW Associate News Editor McLean Dies

Kenneth N. McLean, associate news editor of *Electrical World,* died last week of complications following an appendix operation. He was 35.

A Cornell University graduate, he spent several years at International Telephone & Telegraph Laboratories and other electronics firms before joining EW in 1956. He was made northeastern editor in 1959 and associate news editor in 1960.

Surviving are his widow, Gwytha; parents, Mr and Mrs Lawrence D. McLean; and a brother.

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP

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With at least 5 years working experience on protective relays, substation and plant control circuits. Telemetering, load control, and supervisory experience desirable. Engineering education required, degree not necessary. Age to 50. Headquarters in pleasant, gulf front city. Excellent wages and benefits. Company is one of fastest growing utilities in country. Reply with all detail in strict confidence.

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News Scope

POWER SALE—Sale of surplus Bonneville power to California won contingent approval from the Power Advisory Board of the Washington Conservation Dept. The board asked safeguards to protect northwest priority to the power, and stipulated that a coal-fired steam plant should be built in the Roslyn-Cle Elum area as part of the plan. The $266-million connection would pay for itself in ten years, according to estimates by H. Zinder & Associates. The $45-million steam plant would be justified as a back-up for the hydro power.

MORE GEOTHERMAL — Pacific Gas & Electric Co will add a second 12.5-Mw unit at its Geysers geothermal plant. The plant generates electricity with natural steam brought from within the earth. Magma Power Co and Thermal Power Co have developed seven wells at the location bringing natural steam from depths of 500 to 700 ft. At present, the Geysers plant buys steam from only four of the wells to supply its operational unit.

MERCHANDISING — A dispute between appliance dealers and Central Illinois Light Co has arisen over whether or not aggressive merchandising by a utility company is unfair competition and gives the utility a big edge over independent dealers. H. W. Staats, Peoria, Ill., appliance dealer, and eight other area dealers laid this charge down during a meeting with the company. Staats demanded that the company cease merchandising or face dealer "follow through" to get the practice stopped. The dealers claim that the company does not do much about directly aiding them. For its seven-county area the utility has one dealer contact man, they said. CILCO said it has about 8% of the appliance market and said no single dealer would notice the difference if it quit merchandising suddenly. No further meetings are planned, unless the dealers call them, according to W. W. Babcock, CILCO vice president for sales and public relations.

MUNICIPAL INTERCONNECTIONS — Ohio municipals are studying the economics of city interconnections. Shelby, Norwalk, and Oberlin have been told that a 69-kv line connecting their plants would save better than $12 million in 20 years. Cleveland, Painsville, and Orrville are also looking into the possibilities of combining their systems.

SOVIET POWER—An 800-kv dc transmission line between Stalingrad hydraulic power station and Donets coal basin will go into operation this year. The 293-mile "overhead double line" will carry four billion kwhr annually. Meanwhile, the Communist Party's central committee economic organ reported that Soviet agriculture will use four times as much electricity by the end of 1965 as in 1958. The government wants to "complete" electrification of state and collective rural areas by '65.

BUY UTILITY—Agreement has been reached for the purchase of Carpenter Light & Power Co by Pennsylvania Electric Co and Pennsylvania Power Co. Pending state Public Utility Commission approval, target date for closing the deal for the 5,800-customer utility is June 1.

FLOODS—Melting snow and rains caused floods recently on the Cedar and Shell Rock Rivers and tributaries in northern Iowa—but utilities in the area reported minimal damage. In many instances, service was cut off at the pole as a precautionary measure and re-energized later. Iowa Electric Light & Power Co, which had feared for its underground system being built in downtown Cedar Rapids, reported pumping operations had quickly cleared the duct system and, according to a spokesman, "We got by in good shape."

GOVERNMENT OWNERSHIP—"The Problem of Government Ownership of the Electric Light and Power Business," a 25-page booklet presentation of a speech by Edison Electric Institute President Edwin Vennard, has been made available by EEI. Price schedules and information are available by writing: EEI, 750 Third Ave, New York 17.

CLOSING POWER GAP—Rushing to bring electricity to 78 Minuteman missile sites in central Montana, 22 field crews of Montana Power Co are busy building power lines, substations, and other facilities. Power is now at 33 sites.

Advertising Index

Allis-Chalmers Mfg. Co....4th Cover, 6
American Electric Mfg. Co..... 47
Atomics International
Div. North American Aviation, Inc. 8
C&D Batteries
Div. Electric Autolite Co..... 50
California Federal Savings & Loan Ass'n. 66
Chance Co., A. B..... 51
Collins Radio Co..... 45
DeLaval Steam Turbine Co..... 4
Directory of Engineers..... 66
Engineers, Directory of..... 66
General Electric Co.
Apparatus Dept. .....2nd Cover, 65
Graybar Electric Co., Inc..... 7
Indiana Steel & Wire Co., Inc..... 62
KPF Electric Co.....40, 41
Kearney Corp., James R..... 39
Kerite Company 22
Lapp Insulator Co., Inc..... 10
Line Material Industries..... 15
McGraw-Hill Book Co..... 66
Minerallac Electric Co..... 62
Moloney Electric Co..... 49
Natvar Corp. 43
Ohio Brass Co.....55, 56
Orangeburg Mfg. Co.
Div. Flintkote Co..... 21
Pitman Mfg. Co..... 9
Radio Corp. of America..... 17
Reliable Electric Co.....3rd Cover
Searchlight Section 67
Southern States Equipment Co..... 48
Superior Cable Corp..... 16
Wagner Electric Corp..... 61
Westinghouse Electric Corp...18, 19, 20
PROFESSIONAL SERVICES 66
CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.
EMPLOYMENT OPPORTUNITIES .. 67
EQUIPMENT
(Used or Surplus New)
For Sale 67

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an eighteen minute sound-color film produced by the Reliable Electric Company to demonstrate deadending and splicing by the newest mechanical methods with particular attention to live-line work.

Interesting scenes include field installation procedures; heavy short circuit tests, tensile and vibration tests and a few manufacturing details.

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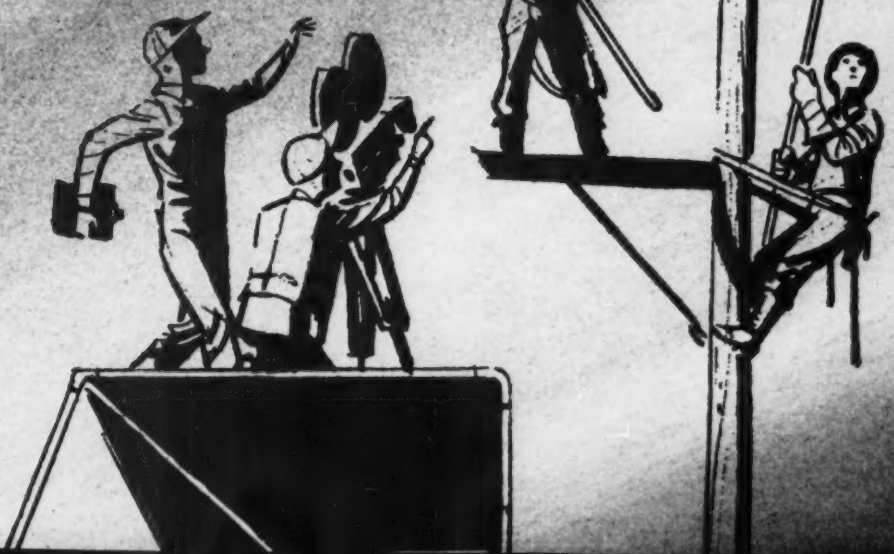

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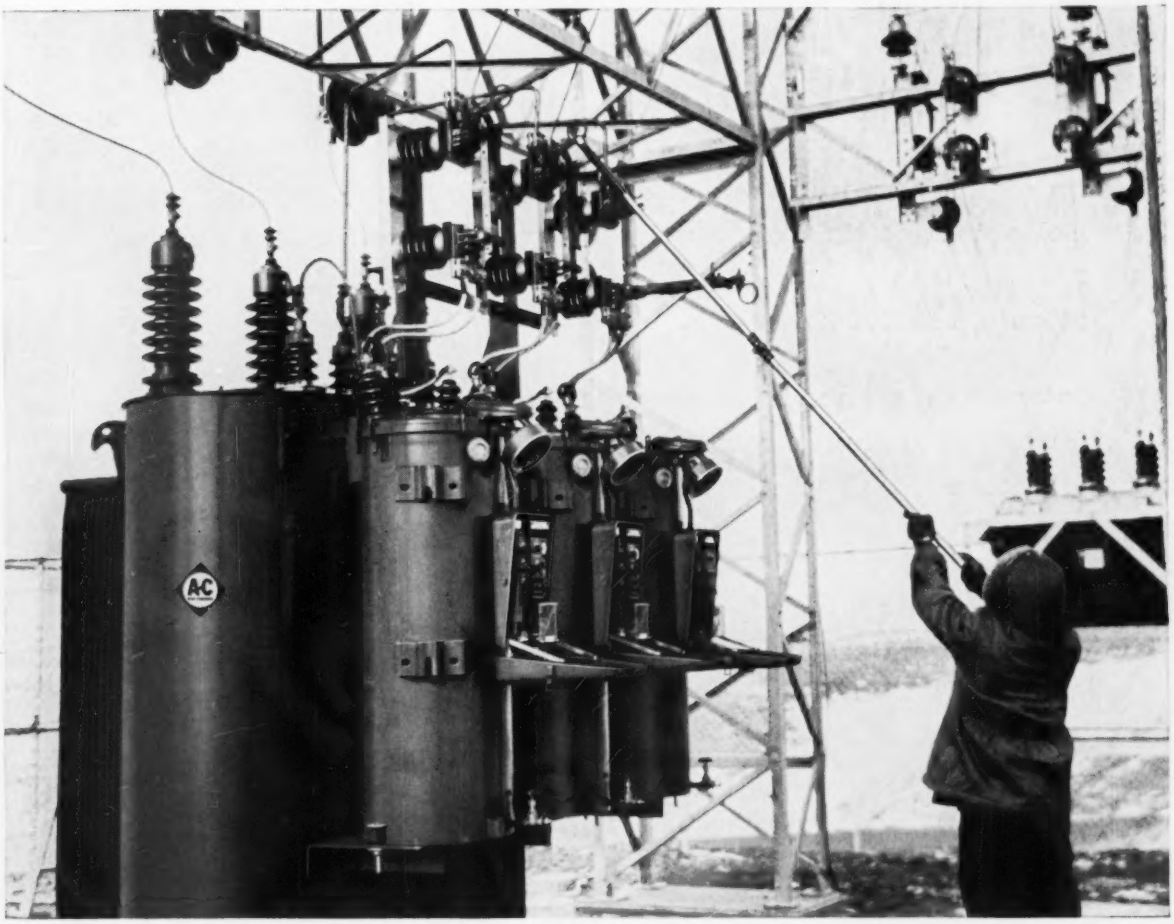

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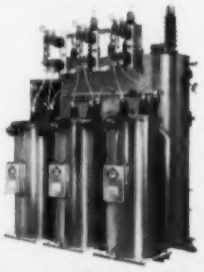

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